ATTACHMENT 11
PROCESS DESCRIPTION

11.1 INTRODUCTION

The Munitions Management Device, Version 1, (MMD-1) is a transportable, prefabricated treatment system structure consisting of process and support utility systems designed to detoxify chemical warfare materiel (CWM) contained in nonexplosively configured, non-stockpile chemical weapons. The MMD-1 will be tested using recovered non-explosively configured
non-stockpile and reconfigured stockpile CWM and Department of Transportation (DOT) cylinders containing nerve agents isopropyl methyl phosphorofluoridate (GB), O-ethyl-S-(2 diisopropylaminoethyl) methylphosphonothioate (VX), mustard (H/HD), and the industrial chemical phosgene.

Table 11-1 presents the chemical agents and industrial chemicals that will be detoxified by the MMD-1 and their associated reagents. The chemical agent or industrial chemical will be detoxified until the chemical concentrations are less than or equal to the treatment performance level goals. **Tables 11-2 and 11-3** present the treatment performance level goals for liquid and solid wastes, respectively. Treatment operations will be conducted in a batch mode. Confirmational analysis will be performed to verify treatment effectiveness to treatment performance level goals.

Table 11-1. MMD-1 Chemical Agents, Industrial Chemicals, and Reagents

Chemical Agent/Industrial Chemical	Reagent
HD	MEA and water
GB	MEA and water
VX	MEA and NaOH
phosgene (CG)	NaOH and water

NOTES:
GB = Sarin
HD = Distilled mustard
MEA = Monoethanolamine
NAOH = Sodium hydroxide
VX = O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothioate

Table 11-2. Chemical Agent Treatment Performance Level Goals for Liquid Wastes

Chemical Agent Treatment Residues	Treatment Performance Level Goals mg/L
HD and MEA/water	1
GB and MEA/water	1
VX and MEA/NaOH	1

NOTES: MEA-Monoethanolamine, mg/L-milligram per liter, NaOH-Sodium hydroxide

Table 11-3. Chemical Agent

Treatment Performance Level Goals for Vapors and Solid Wastes

Chemical Agent	Treatment Performance Level[a] Goal (mg/m^3)[b]	ppmv[c]
Mustard (HD)	0.003[d,e]	0.00045
GB	0.0001	0.00002
VX	0.00001[d]	0.0000009

NOTES:

a Standards based on workplace exposure limits
b milligrams per cubic meter
c Parts per million by volume at 20^{o}C and 1 atmosphere
d Department of the Army, 1992
e Oak Ridge National Laboratory, 1992

The MMD-1 system test will be conducted inside Building 3445 at Dugway Proving Ground (DPG), Utah. The test will be conducted by a U.S. Army Small Burials Contractor (SBC) and selected DPG personnel.

11.2 BUILDING 3445 DESCRIPTION

Building 3445 is a complex consisting of environmental test chambers, support structures, and equipment for testing chemical agents and industrial chemicals. It consists of two test chambers, the East Chamber and the West Chamber. The two chambers are located side by side, are equally equipped, and share a common design, structure, and dimensions. Each chamber measures approximately 34 feet wide by 65 feet long and 15 feet high. Both chambers will be used for the test activities. The East Chamber will house the MMD-1 system and the West Chamber will be used to store reagent product and as a less than 90 day waste storage area. Outside Building 3445 are auxiliary facilities, including the mobile laboratory, break trailers, and the control trailer. Associated structures/equipment within Building 3445 include:

- Breathing air supply
- Carbon filter system
- Control room
- Eye wash/decontamination shower
- Near real-time monitoring room
- Personnel undress room
- Personnel change room/shower
- Personal protective equipment (PPE) storage room.

Figure 11-1 shows the arrangement of the MMD-1 equipment outside Building 3445 and **Figure 11-2** shows the arrangement of the MMD-1 process equipment inside Building 3445.

Building 3445 is constructed of steel structural members and concrete walls. The test chamber flooring, wainscot, and columns are lined with 316L stainless steel sheets welded together to provide a sealed working area. The wainscot protects each interior wall to a height of 8 feet. The concrete walls above the wainscot are painted with chemical-resistant epoxy sealant.

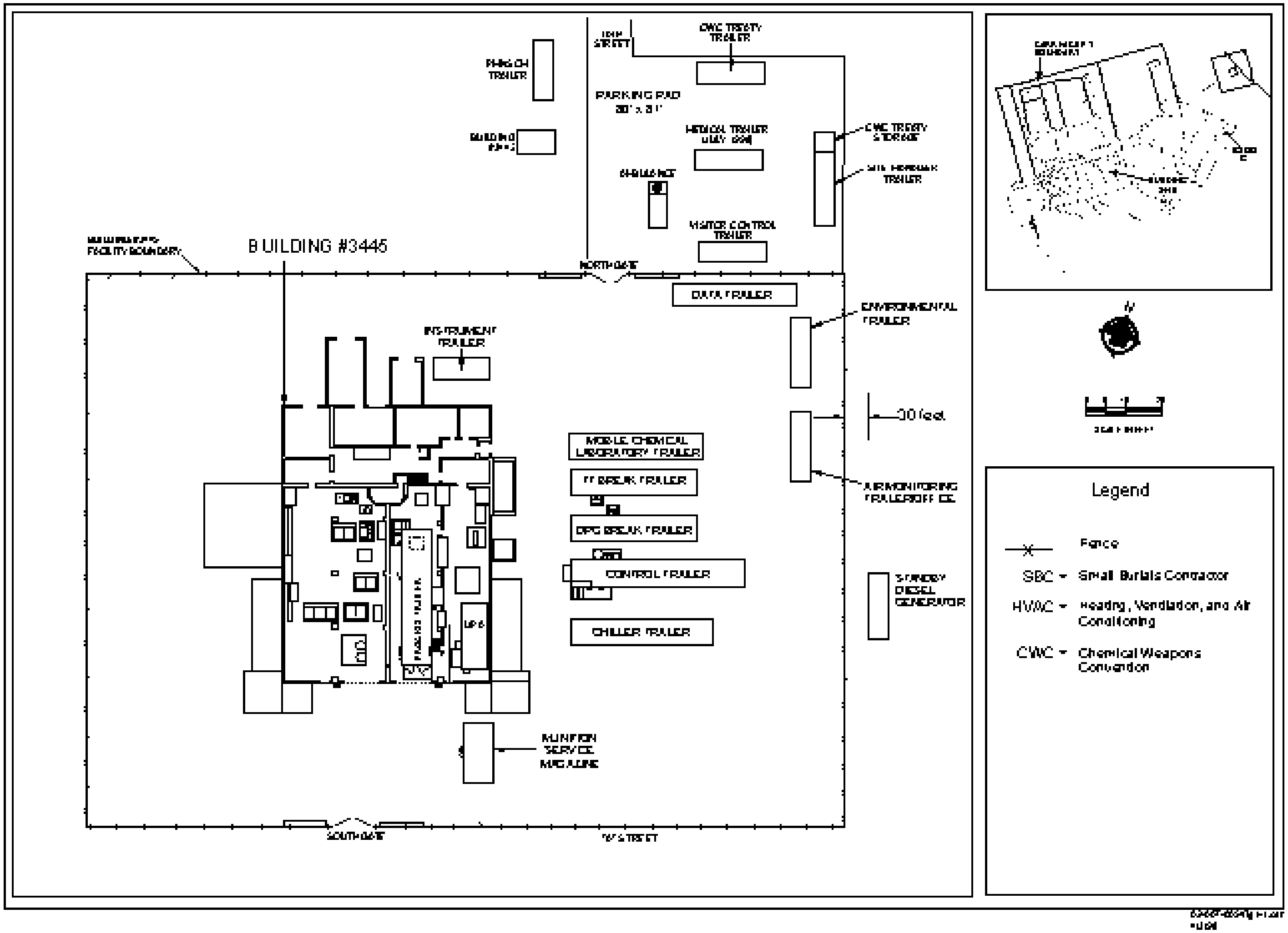


Figure 11-1. Arrangement of MMD-1 Equipment at Building 3445

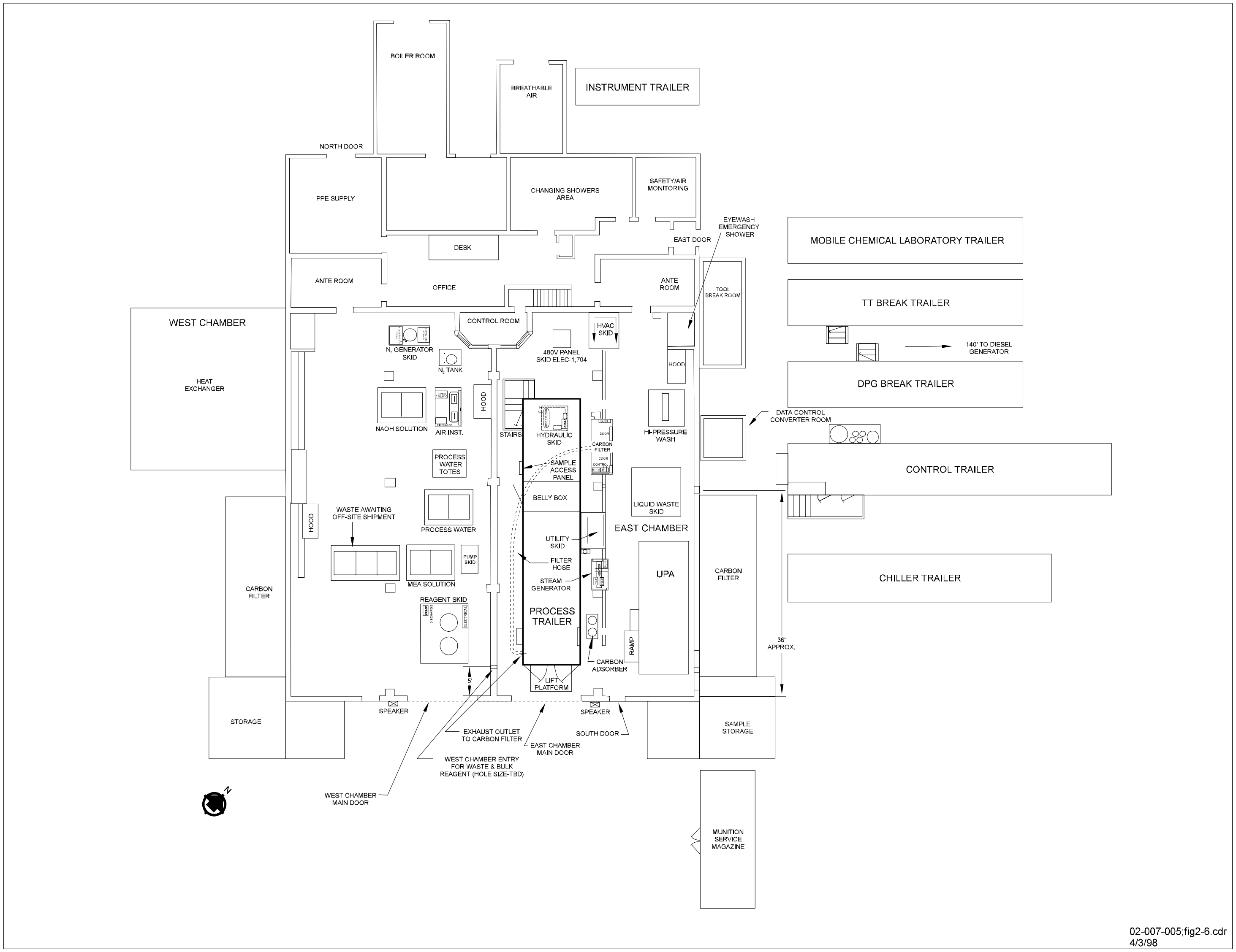


Figure 11-2. Layout of the MMD-1 in Building 3445

Entry/exit to the Building 3445 East Chamber will be through an airlock that connects the East Chamber to the anteroom, which is equipped with interlocking doors. The anteroom=s first door provides access from the anteroom into the airlock in the East Chamber. The other interlocked door provides access from the anteroom to the shower/change area. First, second, and third stage undress procedures are conducted in the airlock and anteroom before a worker enters the shower. Break/lunch facilities will be located in trailers that are outside and separate from Building 3445.

Building 3445 was designed and constructed at DPG to fully test and evaluate Department of Defense equipment, materiel, and defensive chemical/biological systems. It was designed to contain all toxic materiel within its test chambers. To ensure that no toxic materiel is released into the atmosphere, Building 3445 is fundamentally airtight and is operated at a slight negative pressure relative to surrounding modules and the atmosphere, thereby ensuring that any leakage remains in a test chamber.

11.2.1 Building 3445 Utility System Description

This section describes the electrical, lighting, heating, ventilation, and air conditioning (HVAC), fire protection, and communications equipment present at Building 3445.

11.2.1.1 Electrical

The Building 3445 electrical service consists of a 480-V, 600-A service, 150-A service for the building systems, 1,400-A service at other voltages, and standby power supplies. The MMD-1 system will require a connection to the Building 3445 480-V service. The Building 3445 standby power supply consists of portable diesel generators. Additional standby generators with 15, 30, 60, 100, 150, and 200 kW capacities are available at DPG and may be used as needed.

11.2.1.2 Lighting

Interior lighting provided in each chamber of Building 3445 consists of four rows of fluorescent light fixtures, two rows located on each side of the dividing column. Each row contains six light fixtures. Emergency lighting systems consist of a double lamp fixture located over the doors to each anteroom.

11.2.1.3 Heating, Ventilation, and Air Conditioning

The Building 3445 HVAC system is designed to heat, cool, and condition the ventilation air and to maintain a negative pressure atmosphere. The building is heated by an oil fired steam system and electric heaters. Each chamber is heated by two 30-kW electric, duct-mounted heaters. Cooling is provided by two roof mounted air conditioning units. Cooling can be maintained in the building at 68°F plus or minus 0.2 degrees with an ambient temperature of 90°F. The heating and cooling system use a common duct system.

Building 3445 is equipped with a 10,000 cubic feet per minute carbon adsorption filter system for filtering air exhausted from each chamber and for maintaining negative atmospheric pressure. This filter system maintains a negative atmosphere of 0.25 inch of water for containment of chemical agent vapors within a chamber. Air exhausted from Building 3445 will be filtered and monitored for residual contamination before venting to the atmosphere. The direction of air flow within Building 3445 is shown in **Figure 11-3**.

11.2.1.4 Fire Protection

Hand-held fire extinguisher use will be the first means of controlling a fire in Building 3445 during the MMD-1 test activities. There are three ABC type fire extinguishers at various locations at Building 3445: one extinguisher each in the East and West Chambers, and one in the shower/change area. The nearest fire hydrant is located at the southwest corner of the Building 3445 facility fence, accessible from AA@ Street.

11.2.1.5 Operation and Maintenance of Building 3445

Standing Operating Procedures (SOPs) exist for Building 3445 relating to pre-operation, set-up, operation, emergency action, maintenance, and decontamination procedures to be conducted at the building. During the MMD-1 test, personnel will adhere to these SOPs regarding the operation of Building 3445.

11.3 MMD-1 EQUIPMENT AND ASSOCIATED STRUCTURES

The MMD-1 system consists of the following equipment and associated structures:

- Munition Service Magazine
- Unpack Area
- Process trailer (where the treatment occurs)
- Control trailer that will house the control room, a monitoring room, electrical equipment room, and storage
- Skid-mounted equipment (14 skids) such as carbon filtration system, chiller, surge tanks, etc., that will be located adjacent to the process trailer.

The following paragraphs describe the equipment and structures listed above. A list of available drawings for the process and control trailers are provided in **Appendix 11A**.

11.3.1 Munition Service Magazine

The CWM items selected for processing in the MMD-1 test will be stored in a portable storage magazine known as the Munition Service Magazine (MSM). The MSM will be located at the southeast corner of Building 3445, adjacent to the Building 3445 East Chamber. The MSM is a skid-mounted, pre-fabricated, single-story structure approximately 15 feet long by 8 feet high by 7 feet wide. **Figure 11-4** is a general schematic of the MSM.

The exterior of the MSM is constructed of 2 inch by 4 inch galvanized steel studs with two layers each of 5/8-inch gypsum board insulation covered by galvanized steel siding. The exterior surfaces are finished in a white urethane coating that is high impact, corrosion, and abrasion resistant. The roof of the MSM is UL rated and constructed of heavy gauge steel.

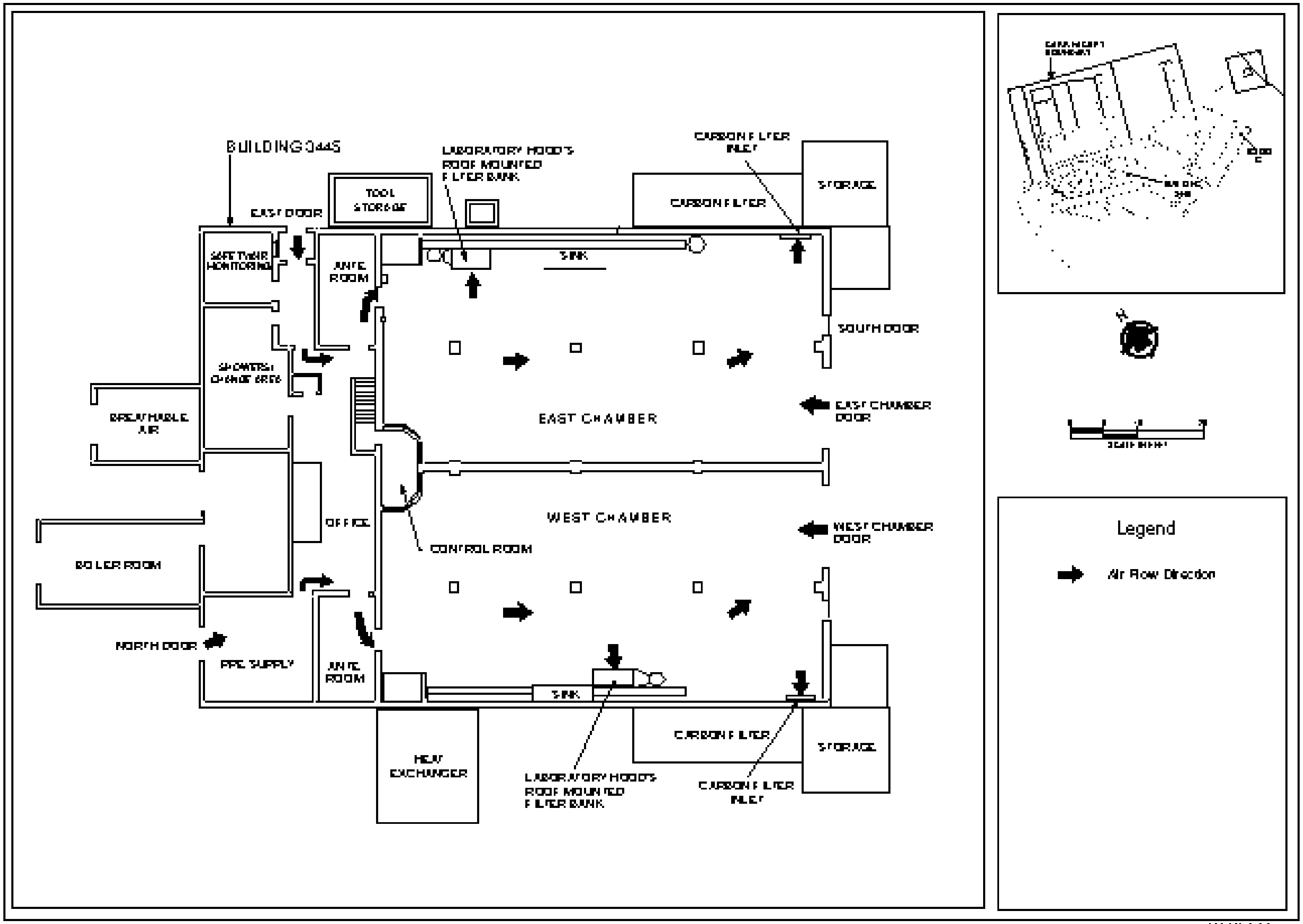


Figure 11-3. Air Flow Direction in Building 3445

Four photocell activated, non-explosion proof lights are located on the exterior of the MSM. Two 1/2 inch ports, one 6 inches above the floor and one 6 inches below the ceiling, are located on each side of the MSM, and are externally accessible to facilitate first entry monitoring. In addition, a manual louver vent has been installed on each end wall and an 8 inch round duct is located on the back wall of the MSM, 1 foot above the floor. The MSM is equipped with a refrigeration unit that is designed to maintain a work space temperature below 58°F. An explosion proof Johnson Control thermostat is mounted on the outside of the building near the door. A carbon air filter unit will be located at the rear of the MSM.

Access into the MSM storage area is provided by a 5-foot wide aluminum loading ramp, which services a 6-foot 8-inch tall by 5-foot wide double door. The door has a 1.5-hour fire rating and is UL classified. The door is equipped with two hooded security locking hasps that are suitable for use with padlocks. An interior panic bar has been installed on one side of the double door.

The interior storage area measures approximately 14 feet long by 6 feet wide. The interior walls and ceiling of the MSM are constructed from two layers of 5/8-inch gypsum board covered with galvanized steel. The walls are protected with a white chemical resistant epoxy coated finish. The MSM has a stainless steel floor grating that is constructed in removable sections that facilitate easy access to the 370-gallon capacity spill containment sump. The interior of the MSM is also equipped with an explosion proof light and a dry chemical fire suppression system.

Only one type of chemical agent or phosgene will be stored in the MSM prior to processing. Recovered munitions will be contained in propellant charge cans that are approximately 36 inches tall and 10 inches in diameter. The largest Department of Transportation (DOT) cylinders are of similar diameter and 54 inches tall. Storage will occur at a single height, one row along each of the three walls (two sides and back). A minimum aisle space of 3 feet will be maintained during storage. Based on the storage area dimensions, aisle space, and size of the propellant charge cans and DOT cylinders, a total of 20 propellant cans or DOT cylinders may be stored at any one time. Chains may be used to secure individual propellant charge cans or DOT cylinders against the walls. The individual propellant charge cans provide secondary containment for the recovered munitions in storage. Storage configuration for CWM items is depicted in **Figure 11-3**.

11.3.2 Unpack Area

The Unpack Area (UPA) is a single story, pre-fabricated skid-mounted structure 22 feet 8 inches long by 8 feet 8 inches wide by 9 feet high. The interior is one whole room, 8 feet wide by 22 feet long by 8 feet tall, with a usable floor space of 176 square feet. The UPA will contain the following equipment:

- Work benches
- Overhead hoist
- Ventilation system and hood
- Carbon adsorption filter system
- Munition transfer cart
- Guillotine saw in a glovebox
- Bead blaster in a glovebox
- Closed-circuit television cameras
- Chemical agent and phosgene air monitors.

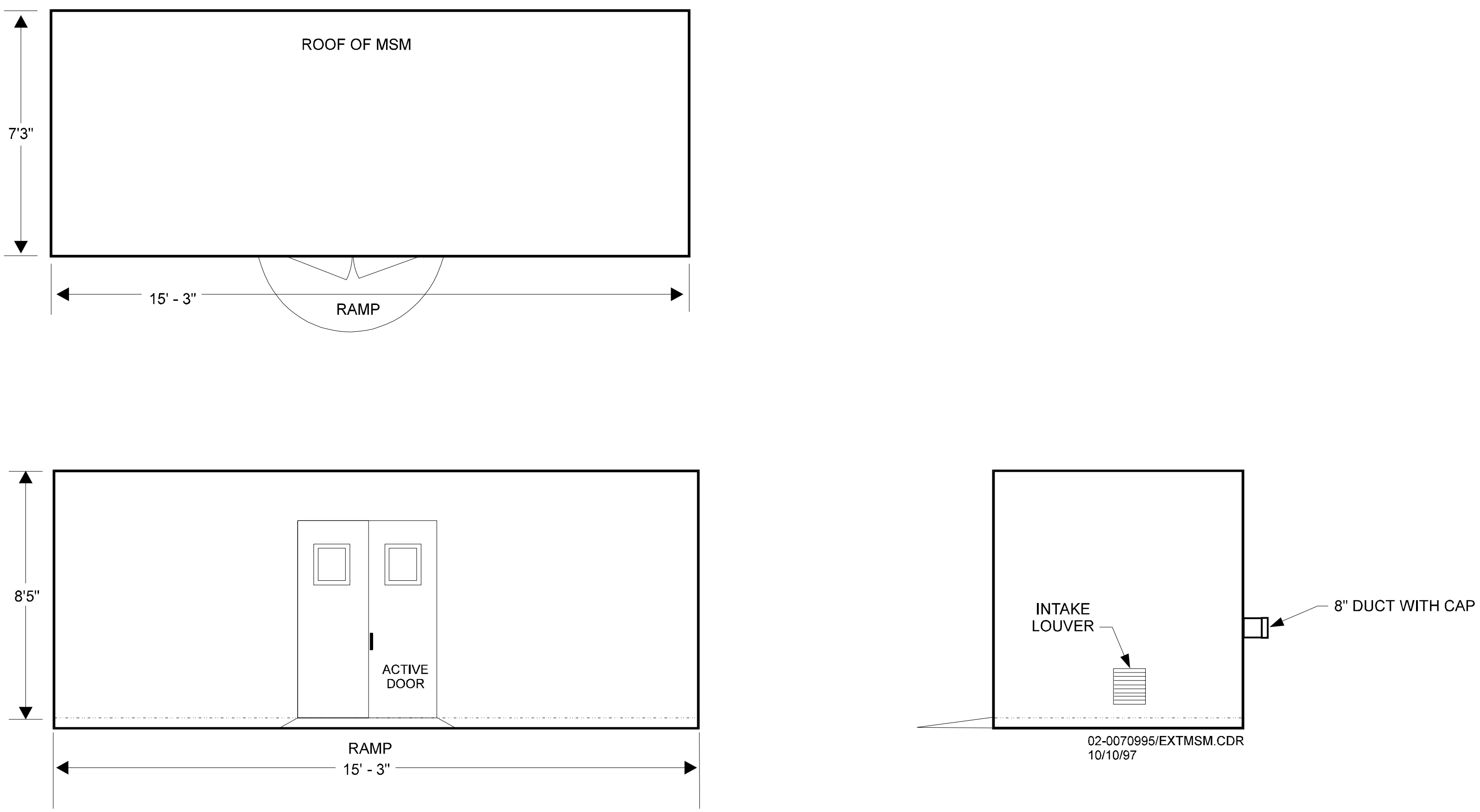


Figure 11-4. General Schematic of the Munition Service Magazine

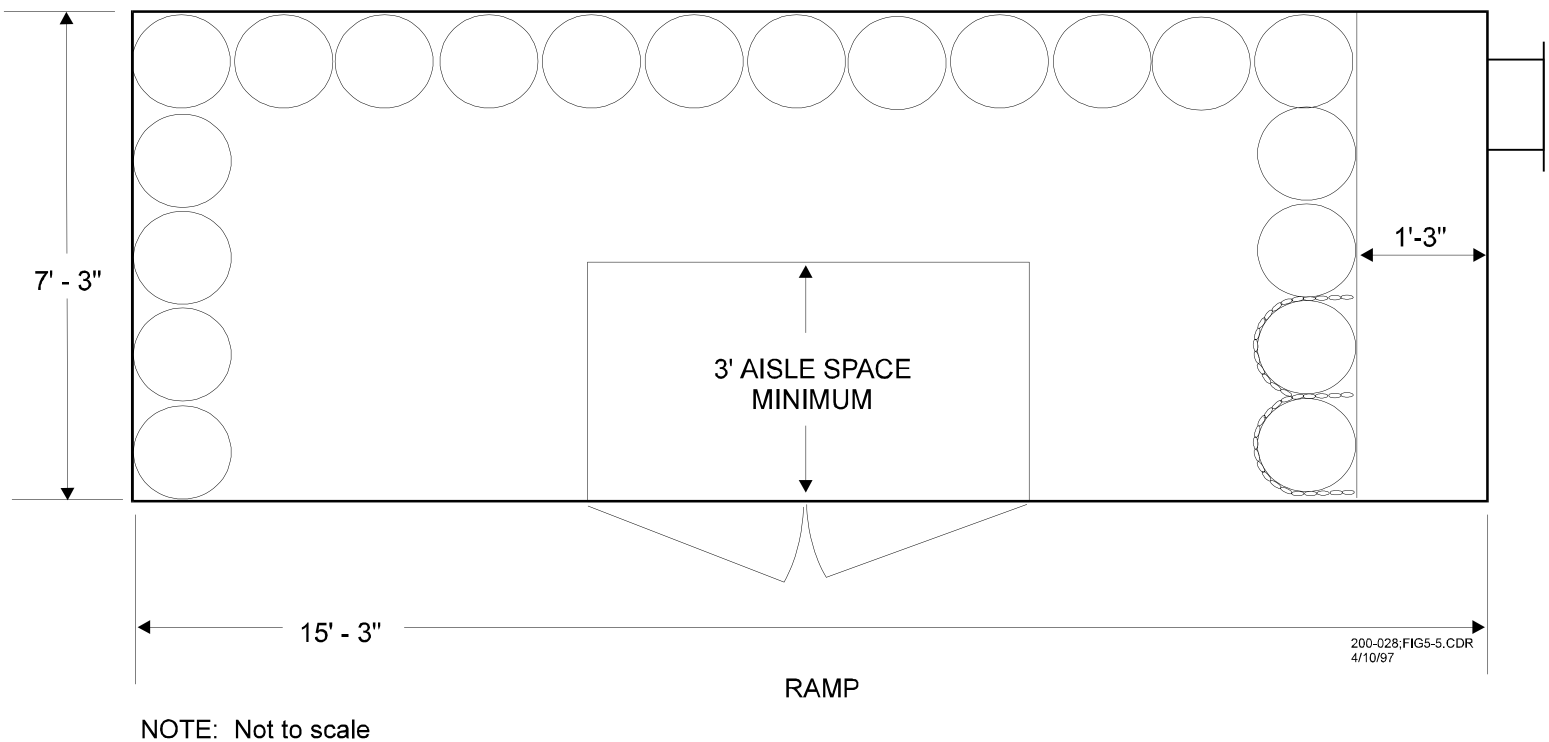


Figure 11-3. Munition Service Magazine Storage Configuration

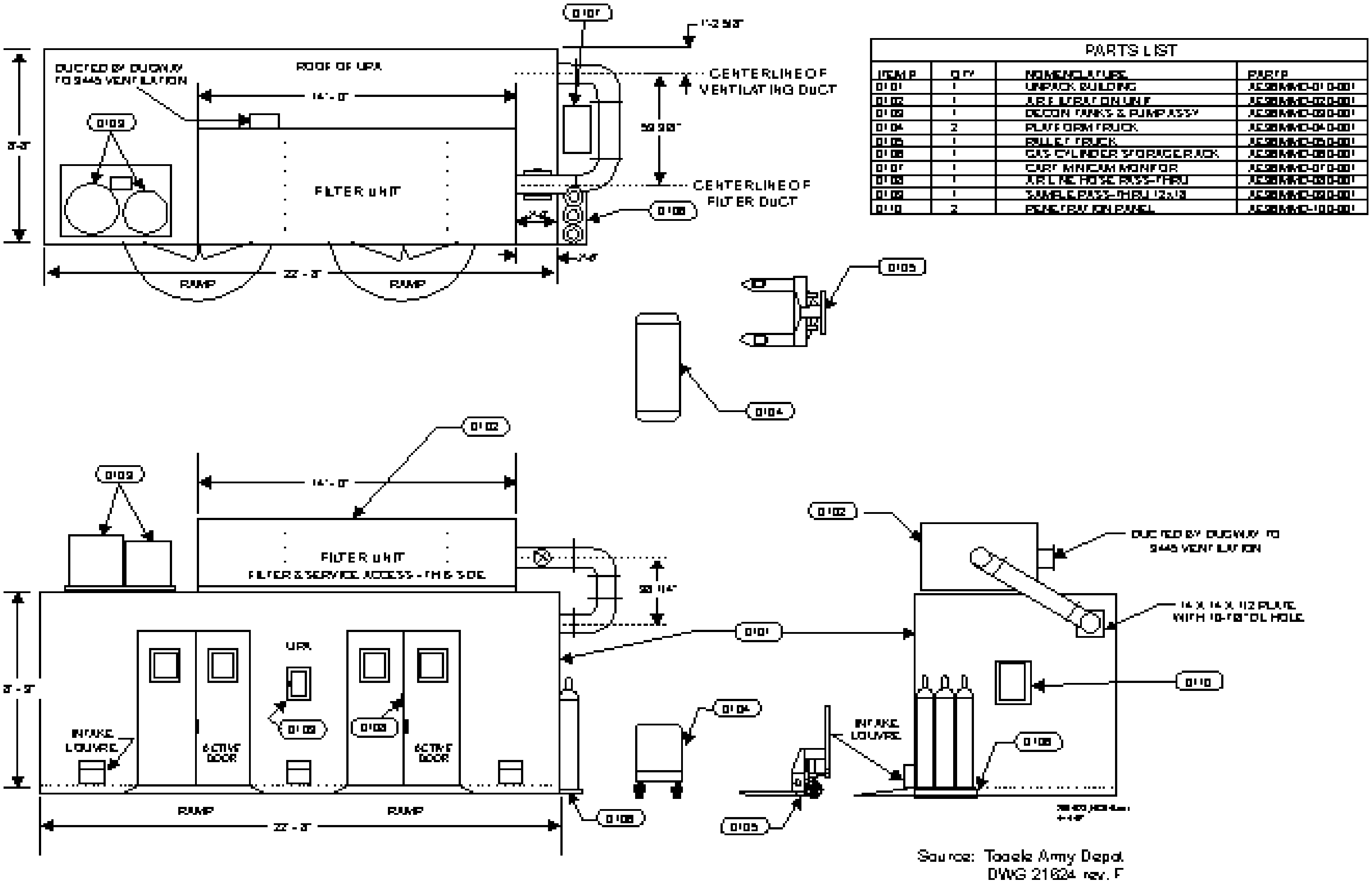
Figures 11-6 and 11-7 depict the external and internal views of the UPA, respectively. Access to the UPA is through 18-gauge steel skin double doors filled with 1 inch cell, 99 pound test resin impregnated honey comb. Each door is accessed by a 5 feet wide and 4 feet long ramp constructed of 3/16-inch diamond plate steel. The ramps have an incline ratio of 1:8 and have sloped sides. Doors are 5 feet wide by 7 feet high and are provided with a panic bar for easy exit. Each door leaf contains a 10 inch 10 inch, 1-1/2 hour fire rated glass observation window. Access for passing equipment, tools, and samples is through the sample pass box that measures 12 inches wide by 18 inches high.

The UPA floor is constructed of 10-gauge stainless steel. The walls and roof are constructed of 12-gauge 304 stainless steel, capable of resisting over 110 pounds per square foot of wind and blast on either side of the roof and walls, and on the floor. The floor is 1 inch deep and constructed of 3/16-inch stainless steel diamond plate. A fiberglass grate rests 1 inch above the floor to prevent any liquids present from contacting equipment and personnel. The floor is designed for a 600 pounds per square foot live load and is capable of providing secondary containment of liquid. The secondary containment calculation for the UPA floor is presented in **Appendix 11B**.

The walls have a 2-hour fire rating, while the ceiling has a 1-hour fire rating. The interior steel finish is covered with two coats of two-component epoxy paint. The exterior steel finish is painted with one prime coat and two coats of a two-component chemical agent-resistant epoxy coating. The roof structure has support points (pads) for mounting a carbon filtration system and a decontamination tank system. These pads will support a 2,000 pound carbon filtration system and a 600 pound roof mounted decontamination tank system. A monorail beam approximately 20 feet long is bolted flush to the ceiling and has a load capacity of greater than 1,000 pounds. Interior lighting is provided by four stainless steel fluorescent fixtures with 100 watt lamps controlled by an interior switch, Underwriters Laboratories, Inc. (UL) listed for hazardous locations.

Inlet air to the UPA is provided by three intake louvres located in front of the UPA which consist of a rain louvre on the outside, an adjustable balanced back draft damper in the middle, and a 1-1/2 hour, fire rated fusible link damper on the inside. The ventilation system consists of a fan, carbon filter unit, and a series of hoods connected to a common flume. The fan and carbon filter unit is located on the UPA roof and will operate at 700 cubic feet per minute with a maximum of 1,000 cubic feet per minute. To capture particulate and vapors, ventilation hoods are located at three work stations inside the UPA. These work stations are the work bench, MTV fixture table, table saw, and beadblast glove box.

The purpose of the UPA carbon filter unit is to remove potential contaminates released during unpacking, decontamination, and packing operations and to prevent potential contaminant leakage into Building 3445 by maintaining the UPA at a negative pressure of 0.25 inches of water relative to Building 3445. The carbon filter unit contains an isolation valve, a filter housing containing a pre-filter, High-Efficiency Particulate Air (HEPA) filter, two High-Efficiency Gas Adsorber (HEGA) (carbon) filter banks in series, another HEPA filter, and an exhaust fan powered by two redundant, independent variable speed motors. A summary of the UPA carbon filter design and operating parameters is presented in **Table 11-4**.



PARTS LIST			
ITEM #	QTY	NOMENCLATURE	PART #
0101	1	UNPACK BUILDING	AE38MMD-010-001
0102	1	AIR FILTRATION UNIT	AE38MMD-020-001
0103	1	DECON TANKS & PUMP ASSY	AE38MMD-030-001
0104	2	PLATFORM TRUCK	AE38MMD-040-001
0105	1	PALLET TRUCK	AE38MMD-050-001
0106	1	GAS CYLINDER STORAGE RACK	AE38MMD-060-001
0107	1	CART MINICAM MONITOR	AE38MMD-070-001
0108	1	AIR LINE HOSE PASS-THRU	AE38MMD-080-001
0109	1	SAMPLE PASS-THRU 12x18	AE38MMD-090-001
0110	2	PENETRATION PANEL	AE38MMD-100-001

Figure 11-6. External View of the Unpack Area

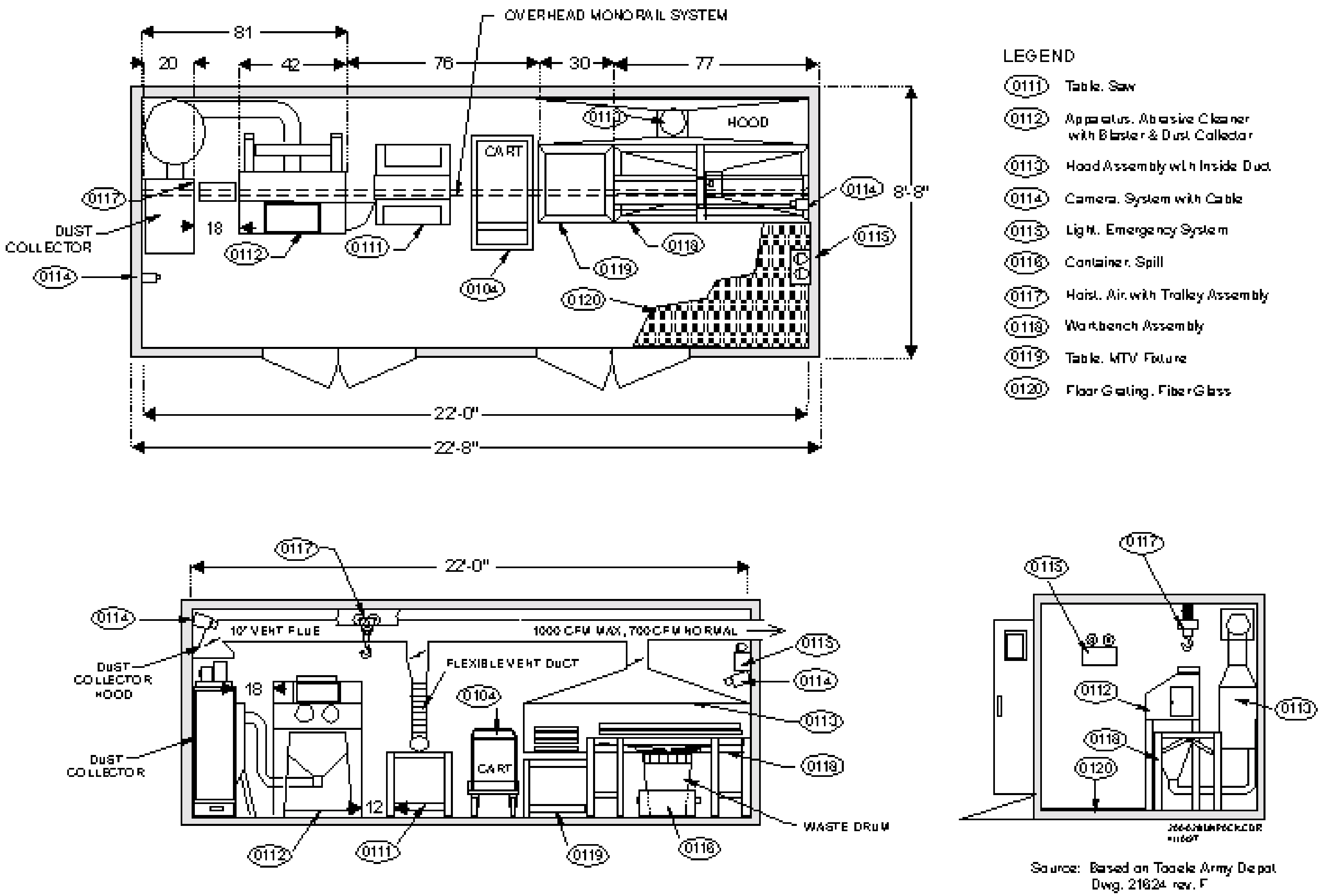


Figure 11-7. Interior Layout of Unpack Area

As the pre-filter and HEPA filters become dirty, the differential pressure across the filters will increase. To maintain a constant flow through the carbon filter and UPA, the motor speed will be manually adjusted on a periodic basis. Each HEGA filter bank provides a 2-inch thick bed of carbon, for a total carbon thickness of 4 inches from two HEGA banks. The HEGA filters contain activated carbon, impregnated with copper, silver and chromium (whetlerized) to improve adsorption of highly volatile compounds such as phosgene. The pre-filters, HEPA and HEGA filters, are of the bag-in/bag-out type which allows filters to be replaced from the exterior of the filter housing without exposing personnel to the contents of the spent filters. Plastic bags surrounding the access openings encapsulate the filters prior to removal.

Electrical power for UPA operations will be provided by the Building 3445 power supply. Fire protection is provided by an internal, self-actuating, dry chemical fire suppression system. The UPA exceeds building, construction, and wiring requirements of the following organizations: National Fire Protection Association (NFPA) (17, 68, 70, 91), UFC, Building Officials/and Code Administrators (BOCA), SBFP, National Electrical Manufacturers Association (NEMA), National Electrical Code (NEC), National Electrical Safety Code (NESC), as well as the American Society for Testing and Materials (ASTM), AISI, and American Welding Society (AWS). It is approved by Factory Mutual with Underwriters Laboratory-listed components and fire wall construction. Gas cylinder supplies needed for air monitoring will be stored in a storage rack located on the south side of the UPA.

Table 11-4. Unpack Area Carbon Filter Design and Operating Summary

Parameter	Range/Value
Flow rate	700 cfm
Pressure - design	24 inch w.g.
Flow configuration	Inlet valve/prefilter HEPA/charcoal/charcoal HEPA/fan
Prefilter - particulate removal efficiency	25 to 35 percent (ASHRAE), medium efficiency
HEPA filters - particulate removal efficiency	High efficiency, 99.97 percent removal of 0.3 micron particulates
Carbon adsorber tray	Type II trays, 3 per bank, 2 banks in series, total 6 trays
Carbon adsorber - thickness of bed	2 inch per bank, total 4
Carbon adsorber - residence time	0.36 second/bank at 700 cfm, total 0.72 seconds
Carbon adsorber - type	Activated, impregnated per MIL-C-13724D, Grade IV whetlerized (ASC), 12 30 mesh
Carbon adsorber - density	0.63 gm/mL
Fan motor power	5 HP each (2 motors)
System design standard	ANSI N509
Carbon breakthrough[a] (estimated)	258 hours

NOTES:
a **Appendix 11D** presents the carbon breakthrough time calculation.

ANSI = American National Standards Institute
ASHRAE = American Society of Heating, Refrigeration, and Air Conditioning Engineers
cfm = cubic feet per minute
gm/mL = gram per milliliter
HEPA = high efficiency particulate air
HP = horsepower
MIL = military
WG = water gauge

11.3.3 MMD-1 Process Trailer

The equipment required for the treatment process, including the Munitions Treatment Vessel (MTV), the liquid reactor vessel (LRV) and gas reactor and associated pumps, filters and piping, will be housed in the process trailer.

The process trailer is a modified, heavy duty flatbed frame, converted to a reinforced box trailer, measuring approximately 44 feet 10 inches long by 10 feet wide by 13 feet 6 inches high. **Figure 11-8** is an external view of the process trailer. The exterior skin is comprised of 0.050 inch aluminum coated with an epoxy-type paint.

The trailer comprises two areas, the process area and electrical equipment area, that are separated inside the trailer by a step. Access to the process trailer is through a single personnel door located outside the electrical equipment area, or during operations, in the process area, via a double door (full width) located on the end of the trailer. Both doors are stainless steel. An exterior portable platform with stairs will be used to enter/exit the personnel door. A powerlift will be used to enter/exit the double doors during process operations.

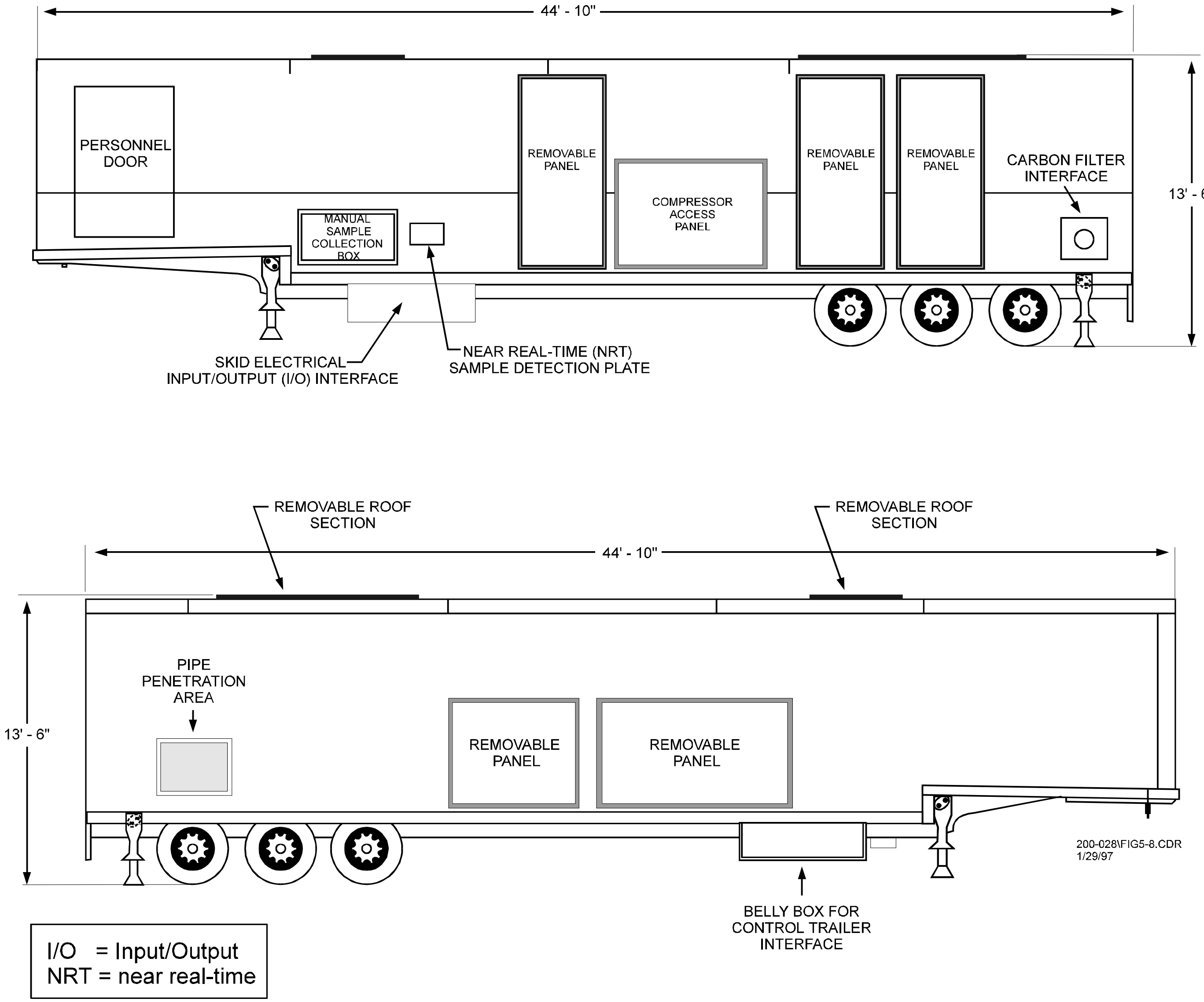
The interior walls and ceiling of the process trailer are made of 12-gauge stainless steel. The walls are 2-15/16 inches thick. The floor is a combination of 12-gauge stainless steel sheets and 1/4 inch stainless steel plates. The walls, ceiling and floor have been continuously welded to form an airtight enclosure. Structural members located in the walls are fabricated from 7-gauge cold-rolled steel. The walls are designed to support 2,000 pounds per linear foot. The ceiling is capable of supporting 100 pounds per linear foot.

The process trailer floor has been strategically supplemented so that the weight of most of the hardware components is transferred to the flat bed trailer structure. The related payload capacity of the trailer is 50,000 pounds.

The process area floor dimensions are approximately 28 feet long by 9-1/2 feet wide and have been constructed to form a 6-inch high leak-proof secondary containment pan. The sump and sump pump are incorporated into this pan and will be used to collect any liquids that might accumulate from condensation, vessel drain points, or leakage. The sump is double-lined stainless steel, measures 0.83 foot wide by 2 feet long by 1.5 feet deep and houses a 1.5 hp sump pump. A raised grated floor is located around the process equipment and will prevent personnel and equipment from coming in contact with any liquids collected in the secondary containment system. Secondary containment calculations for the process trailer secondary containment system are provided in **Appendix 11B**. Calculations show that the containment system meets the regulatory requirements for liquid containment of 100 percent of the largest process vessel (375 gallons). Calculated containment volume is 485 gallons.

Interior lighting is provided by six ceiling mounted, industrial explosion proof fluorescent fixtures.

Figure 11-8. External View of the Process Trailer



The liquid processing, gas processing, and waste gas processing systems are located in the process trailer. Key system equipment includes:

- Munition Treatment Vessel
- Liquid Reactor Vessel
- Reagent Charge Tank
- Gas Sparger
- Waste Gas Knockout Drum
- Gas Reactor
- Gas Reactor Knockout Drum
- Waste Gas Chiller
- Waste Gas Heater
- Carbon Adsorption Unit.

Figure 11-9 depicts the equipment layout inside the process trailer. Other equipment located in the process trailer include:

- Video Cameras
- Near Real-Time Monitors and Monitoring Lines
- Sample Ports and Lines
- Communication Intercoms
- Hoist and Jib Crane (load capacity of 2,000 pounds).

11.3.4 Control Trailer

The MMD-1 process system and skid-mounted equipment will be remotely controlled through the Digital Control and Instrumentation System (DCIS) operated from the control trailer. The control trailer is a modified standard box trailer measuring 53 feet long by 8 feet 6 inches wide by 13 feet 6 inches high. An external view of the control trailer is presented as **Figure 11-10**. The control trailer will be located adjacent to and outside Building 3445.

The interior of the control trailer is partitioned into four areas comprising the monitoring room, control room, electrical equipment room, and storage room. The monitoring room contains the near real-time (NRT) equipment (MINICAMS[7]); the control room contains the DCIS and closed circuit television (CCTV); the electrical equipment room contains the power supply panels, uninterruptible power supply, and diesel transfer switch and the storage area is for general storage. The monitoring and control rooms each have a personnel access door. The equipment and storage rooms are interconnected with personnel doors to the control room. **Figure 11-11** depicts an internal view of the control trailer. Access to the external personnel doors are by a portable platform and stairs.

Both the exterior and interior of the control trailer are painted with a urethane finish. The walls have been reinforced with structural steel members and 3/8 inch fiberglass-coated plywood.

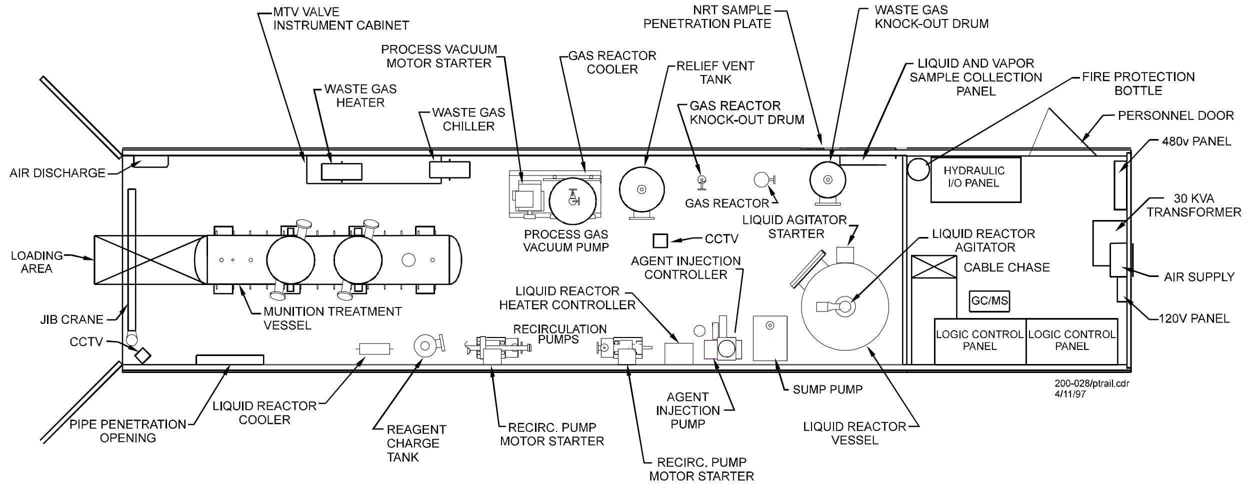
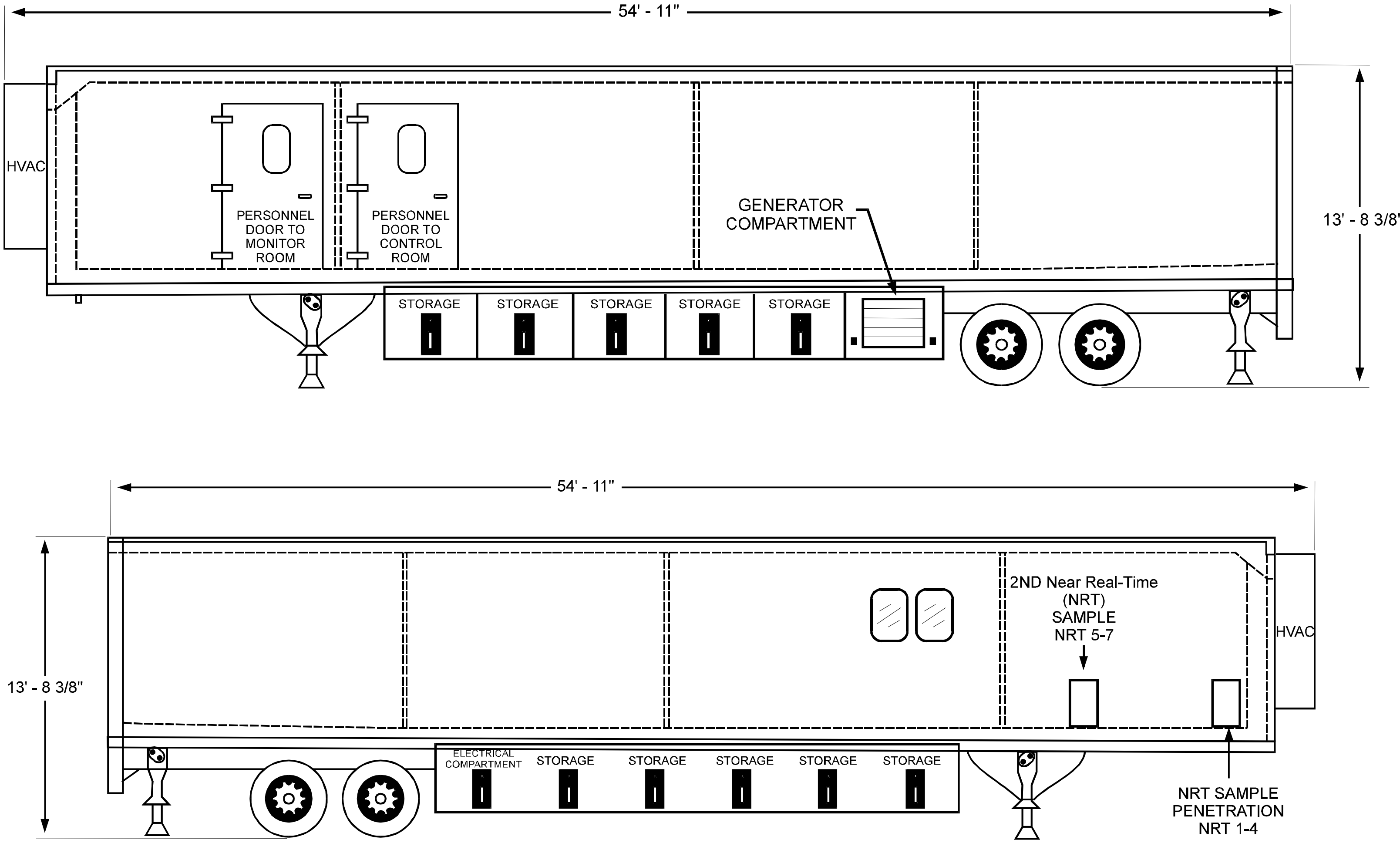


Figure 11-9. MMD-1 Equipment Layout Inside Process Trailer



NRT = near real-time

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Figure 11-10. External View of the Control Trailer

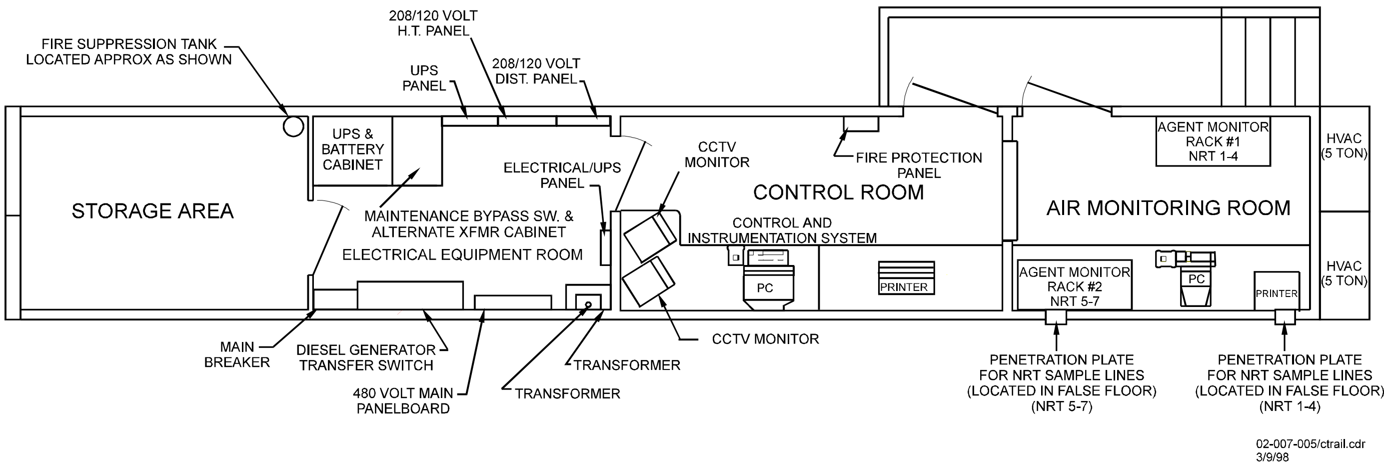

Figure 11-11. Interior Layout of the Control Trailer

11.3.5 Skid-Mounted Support Equipment

Skid-mounted, trailer mounted, and support equipment for the MMD-1 consist of the following:

- Stand-by Generator
- HVAC Chiller
- Surge Tanks
- Reagent Storage Tanks
- Utility Skid (electrical distribution)
- Utility Skid (water, steam, air)
- Hydraulic Skid
- Steam Generator
- High Pressure Wash
- Carbon Filtration System
- Carbon Adsorption Unit
- HVAC Skid (chilled water distribution)
- Instrument Air
- Nitrogen Generator
- Reagent Transfer Pump.

The support skids listed above, with the exception of the diesel generator and the HVAC chiller, will be located within Building 3445 (see **Figure 11-1**). The diesel generator will be placed outside the Building 3445 fenceline. The HVAC chiller will be located next to the control trailer. Detailed physical descriptions and operating descriptions (by system) for the skid-mounted equipment are provided in Section 11.5.

11.4 GENERAL PROCESS DESCRIPTION

The general treatment process flow for CWM in the MMD-1 is presented in **Figure 11-12**. This process description is applicable for the treatment performed during the MMD-1 test at DPG and, in general, for treatment performed at remediation sites where the MMD-1 could be employed. Processing begins with the storage of CWM items at the test site, followed by preparation of CWM items for treatment in the MMD-1; treatment in the MMD-1, then temporary storage of hazardous wastes generated.

11.4.1 Storage and Handling of CWM Prior to Processing

In general, the MMD-1 treatment system would be brought to a site that has accumulated recovered CWM. At DPG, recovered CWM that has been selected for the MMD-1 test is currently stored in Igloo G and will be transferred to the MSM located at Building 3445 prior to processing. Four transfers of CWM items from Igloo G will occur. Transfer of CWM items will be in the order of: (1) CG, (2) GB, (3) VX, and (4) HD. Only one type of chemical agent or industrial chemical will be stored in the MSM at a time or processed during a single campaign.

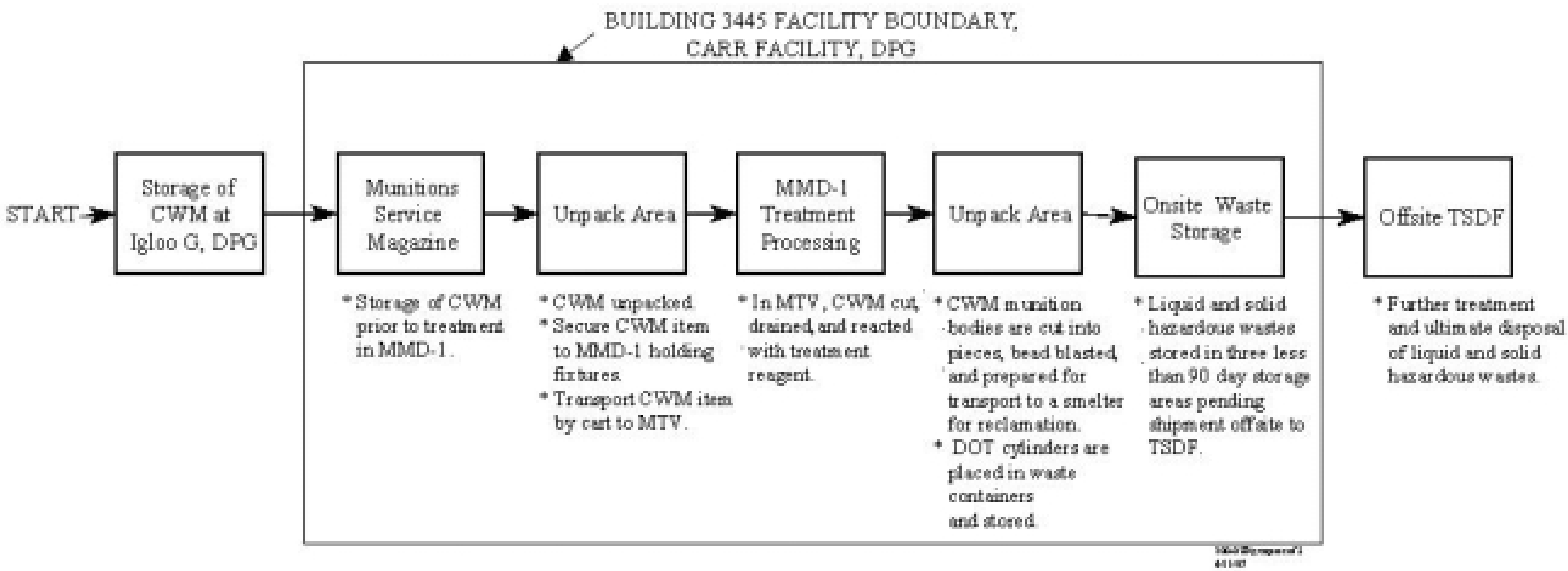

Figure 11-12. General Treatment Process Flow for Treating CWM

11.4.2 Unpack Area - CWM Preparation

Prior to treatment, a CWM item (munition or DOT cylinder) will be prepared for processing. Although one to four CWM items will be processed per day in the MMD-1, only one CWM item at a time will be handled in the UPA or processed in the MMD-1. A CWM item will be manually removed from the MSM and transferred into the UPA using a transfer cart. A variety of operations will be initially performed in the UPA, including unpacking the CWM munitions; securing the MMD-1 holding fixtures to CWM or DOT cylinders; and preparing the munition or DOT cylinder and fixture for transport to the MTV. The munition and fixture will be transported to the MTV using a transfer cart and will be loaded into the MTV using a hoist.

11.4.3 CWM Treatment

The treatment of CWM in the MMD-1 requires that the chemical agent or industrial chemical in the CWM be brought into contact with treatment reagents in the MTV. The MMD-1 design was based on a 500-pound phosgene bomb which represents a worst case munition type and agent quantity. Only one munition or DOT cylinder will be processed at a time in the MMD-1. To accomplish contact between the chemical agent or industrial chemical and the treatment reagents, the CWM item is positioned in the MTV and cut using an end-mill or hole saw. Vapors released from the CWM item are monitored by a gas chromatograph/mass spectrometer (GC/MS) to confirm the type of chemical agent or industrial chemical fill. Once the chemical fill has been verified, the appropriate reagent is pumped into the MTV. The CWM item is then rotated and drained into the MTV. Chemical agent/industrial chemical and reagent mixture are mixed and allowed to react. The MMD-1 system is primarily operated as a liquid-liquid reaction, which provides the majority of the treatment. Vapors present in the reactor vessels are then processed in the gas and waste gas systems. This description represents the basic treatment process. However, the MMD-1 system does allow for some flexibility in its operation. For example, the reaction can occur in either the MTV or the LRV, the primary reactor vessels.

11.4.4 Unpack Area - CWM Container Post Treatment Management

Once treated, the munition bodies or DOT cylinders will be removed from the MTV and transported back to the UPA. Munitions will be removed from the MTV fixture, placed in containers and accumulated until sufficient inventory is present to begin post-treatment processing. Post-treatment processing of munition bodies consists of size reduction and abrasive blasting in order to meet the acceptance requirements of the Rock Island Arsenal for smelting and reclamation.

DOT cylinders will be transported to the UPA, removed from the MTV fixtures, placed in containers, and managed as recyclable waste.

11.4.5 Onsite Hazardous Waste Storage

Post-treatment wastes and other process wastes will be temporarily stored in less than 90 day waste storage areas pending shipment offsite to a permitted TSDF for further treatment and/or ultimate disposal. Both solid and liquid hazardous wastes will be generated during the MMD-1 process. Solids include CWM containers; residues from MTV strainers; plastic, soil, and other debris from CWM remaining after treatment; and overpack material from CWM items such as propellant charge cans, rags, and other packing material. Other solid hazardous wastes generated from the MMD-1 process include personal protective equipment and clothing, bead blast material and contaminated equipment parts such as saw blades. Liquid hazardous wastes generated will include neutralent (reacted chemical agent and reagent); rinse waters, spent decontamination solutions (resulting from any spill cleanup); spent cooling water, spent canned pump reservoir fluids and spent hydraulic fluids. Less than 90 day waste storage areas will be located in the UPA, the West Chamber of Building 3445, and southeast of Building 3445 on AA@ Street. A detailed description of the wastes generated from the MMD-1 treatment process is presented in Section 4 of this permit application. All wastes generated will be properly containerized, labeled, and characterized to ensure proper management. Waste management activities are described in Section 11.9.

11.5 DETAILED MMD-1 TREATMENT PROCESS DESCRIPTION

This section presents a detailed description of the MMD-1 treatment process. The MMD-1 contains equipment for processing chemical agent or industrial chemical in both liquid and gaseous phases. The MTV and the LRV are shared by both liquid and gas process systems and are the primary areas where actual treatment of chemical agent or industrial chemical occurs. Chemical agent or industrial chemical in the liquid phase can be treated in both the MTV and the LRV, and gaseous phase chemical agent or industrial chemical is treated in the LRV, using various combinations of MMD-1 equipment, as determined by the type and quantity of chemical agent or industrial chemical processed. In general, the less volatile chemical agents mustard (H), sarin (GB), and VX will be treated using the same basic sequence and the more volatile industrial chemical phosgene (CG) use another basic sequence. A variation of the basic sequence will be used to treat sarin (GB) and large containers of phosgene (CG). **Figure 11-13**, MMD-1 Treatment Process Flow, shows the overall process flow. **Figure 11-14** shows the equipment in the UPA, **Figure 11-15** shows the equipment in the liquid processing system, and **Figure 11-16** shows equipment in the gas and waste processing system.

11.5.1 CWM Item Handling Prior to Processing

A CWM item will be brought from the MSM to the UPA prior to processing. Operations performed in the UPA will be performed by personnel wearing OSHA Level A PPE. The CWM item will be manually removed from the MSM and placed on a munitions transport cart. Heavy items will be lifted using a hoist that is attached to the MSM. The operators will transport the cart to the UPA, unload the CWM item using a hoist, and place the CWM item on the work table. The overpacked munition or DOT cylinder will be prepared for processing. The munition will be removed from the overpack, typically a propellant charge can which is equipped with a removable top. Removal of the CWM item will first be attempted through the removable top, but will be removed by sawing or cutting the container using air driven hand tools if required. Once in the UPA, the CWM item will be monitored to determine if it is leaking. Air monitoring of the overpack with a gross-level MINICAMS[7] will be performed first to determine if the overpack container is leaking. Next, the CWM item will be visibly inspected when it is removed from the overpack to determine if it is leaking liquid. If it is not visibly leaking, the munition will be monitored for vapor leaks. Vapor monitoring entails placing the CWM in a 6-mil plastic bag and collecting vapors for 15 minutes. The interior of the bag will then be sampled and analyzed with a MINICAMS[7]. If determined to be leaking, the Lead Operator will decide to either continue preparation of the item for MMD-1 processing or to reject the munition for processing.

Leaking items that are processed in the MMD-1 will first be patched using plaster of paris or pig putty, a mixture of flour, salt and water, to repair and stop the leak. If these efforts are unsuccessful but the operators determine that the CWM item can be attached to the MTV fixture and transferred to the MTV without spilling chemical agent/industrial chemical or releasing vapors above IDLH level concentrations, the item may be treated as planed. Otherwise, the item will be re-containerized, and returned to storage in Igloo G.

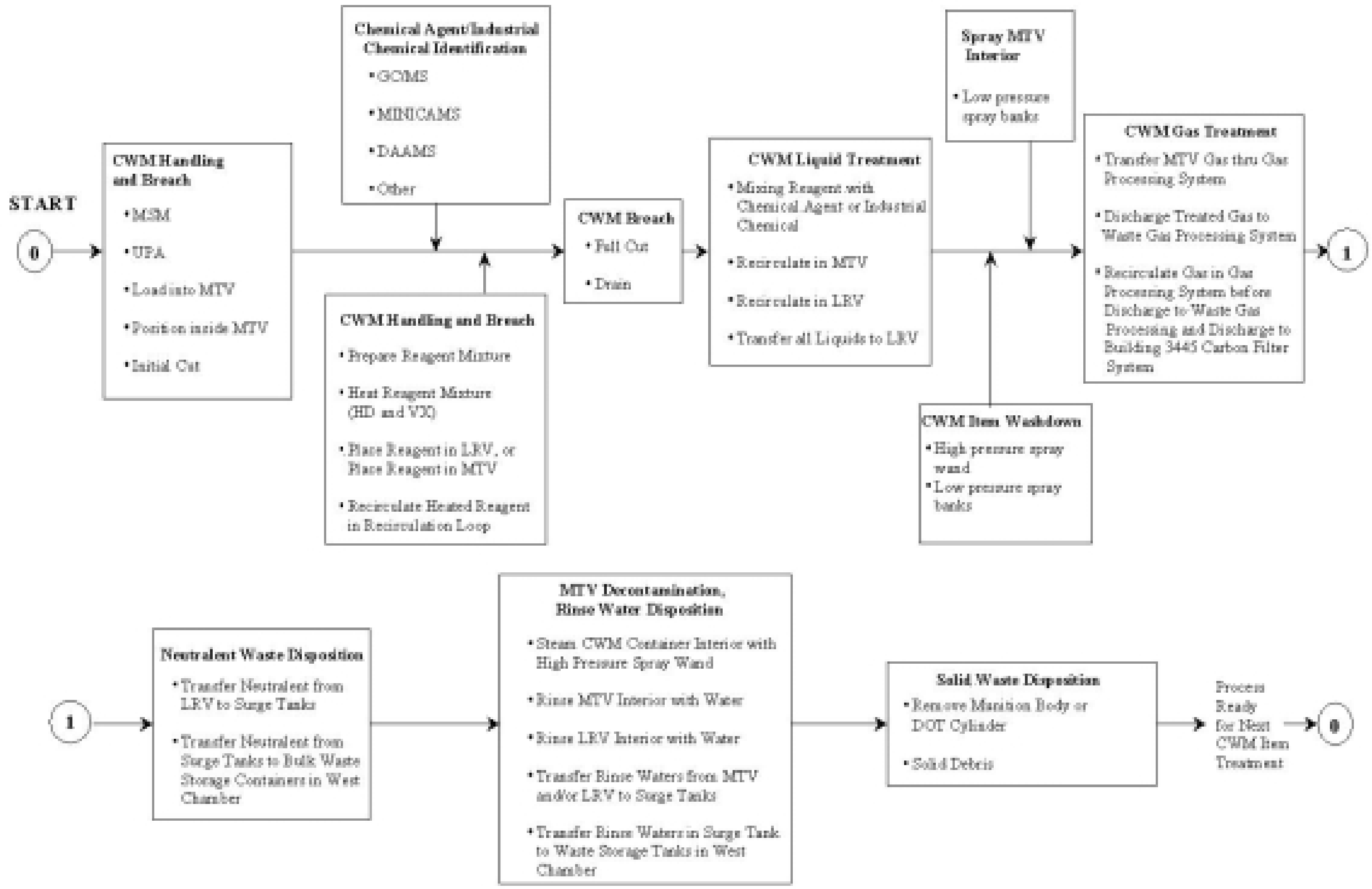

Figure 11-13. MMD-1 Treatment Process Flow

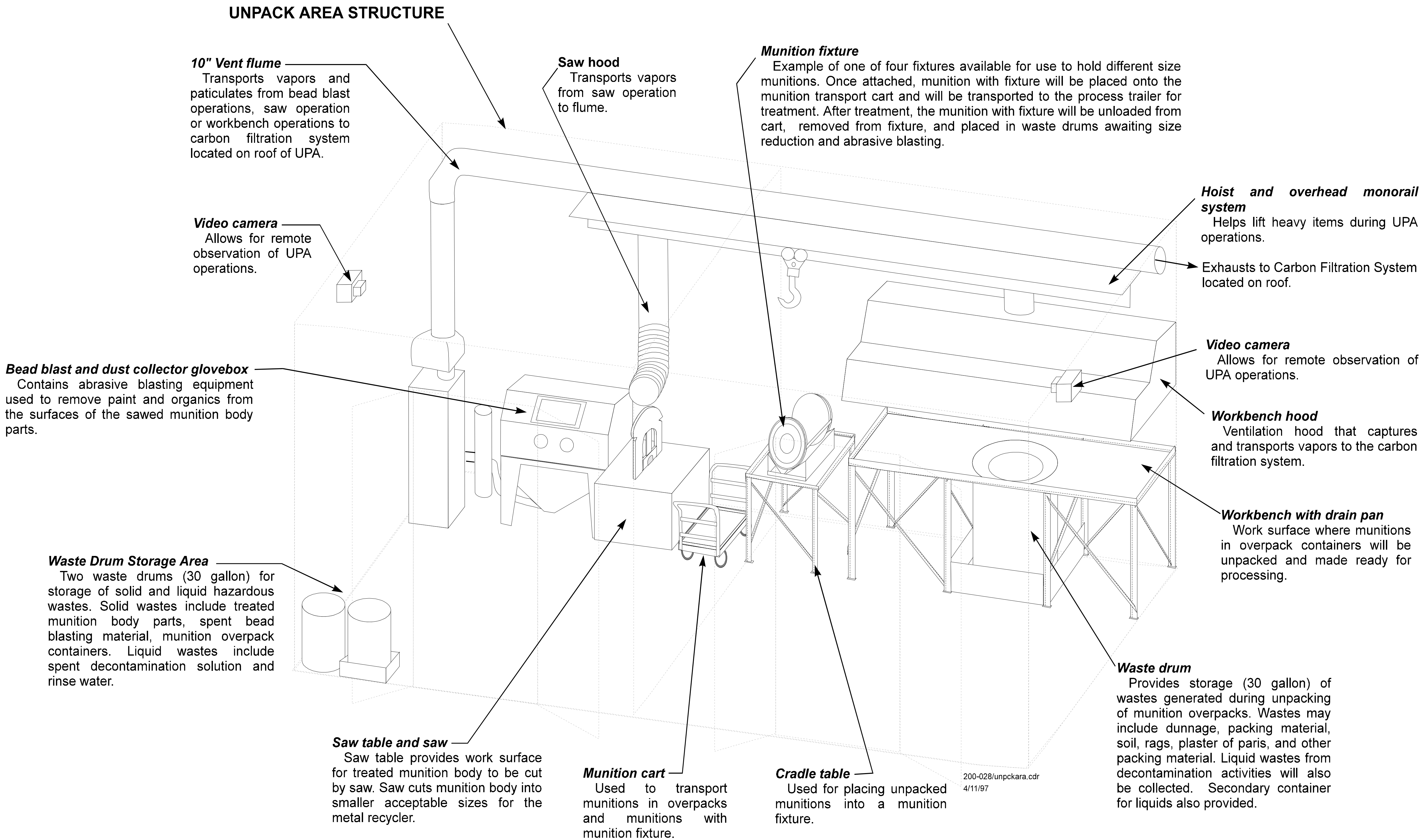

Figure 11-14. Unpack Area

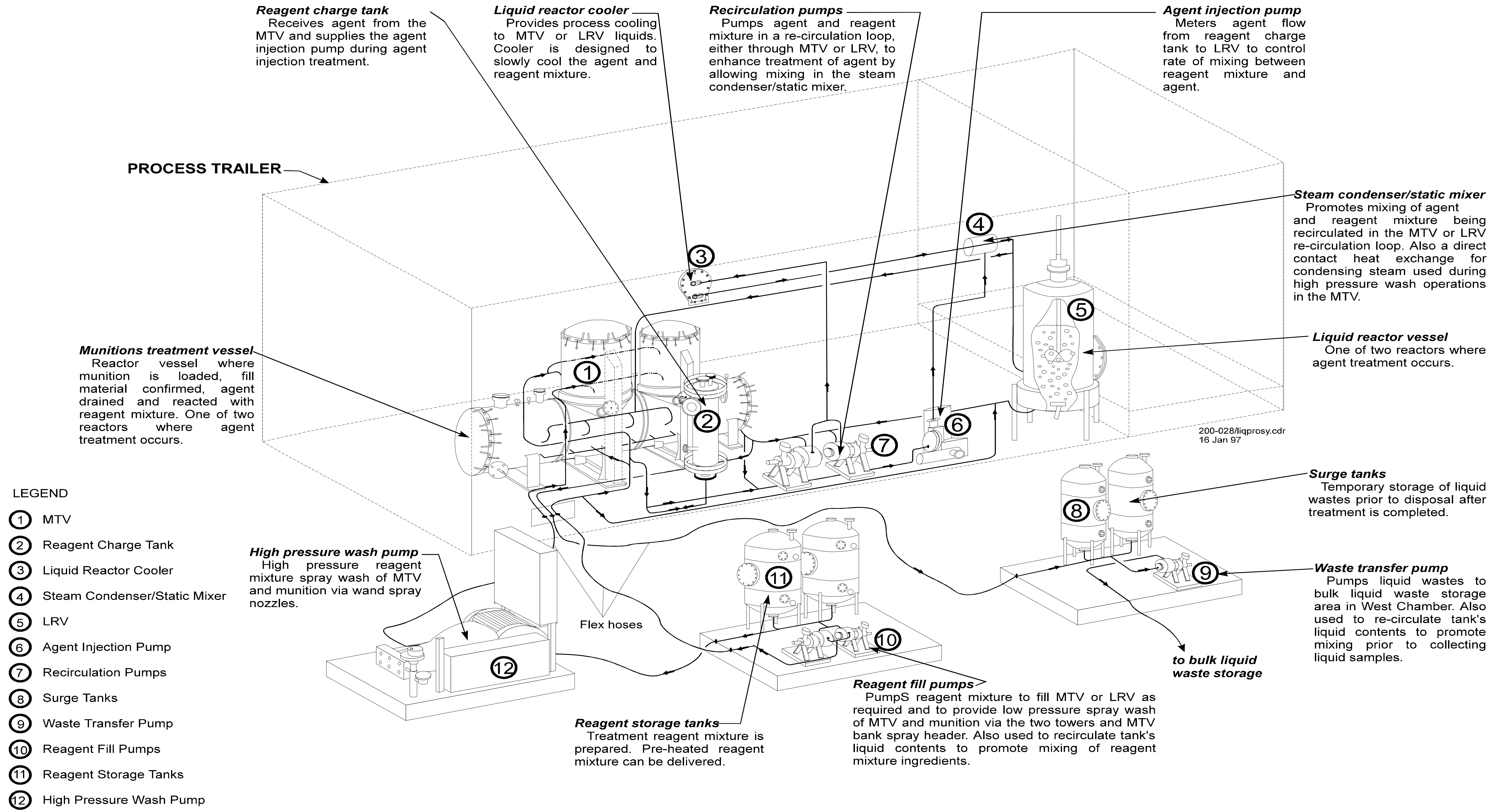

Figure 11-15. Liquid Processing System

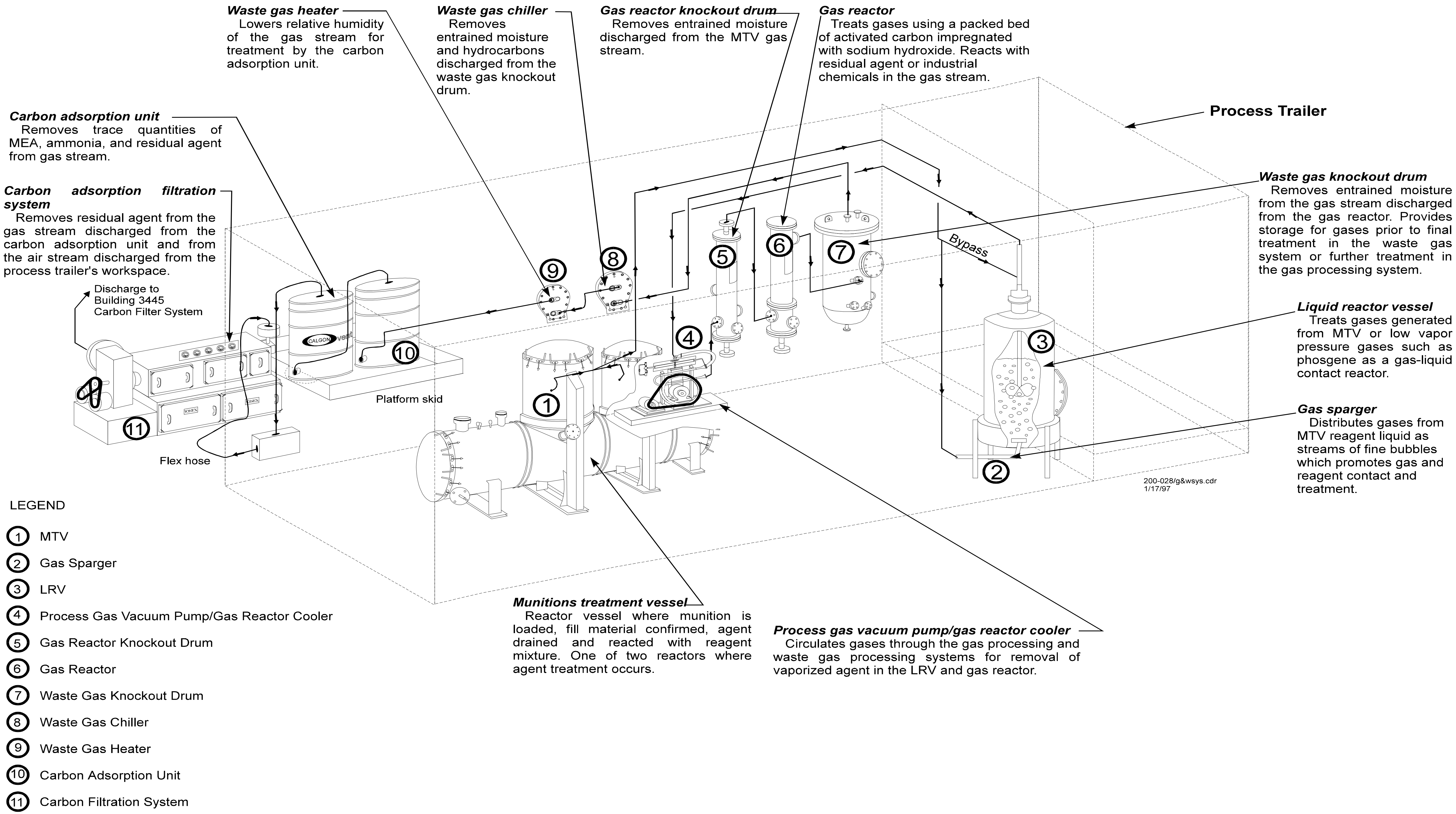

Figure 11-16. Gas Processing and Waste Gas System

Once the item has been unpacked, the CWM item will be identified by type, measured, photographed, and assessed to determine whether it will fit within the munition fixture used to secure the CWM item in the MMD-1 treatment vessel and to establish the tooling tower configuration requirements. The MTV tooling towers are configured with various cutting tools and clamp feet, as dictated by the type and size of CWM item to be processed, prior to loading it into the MTV. It is then attached manually to the munition fixture and again monitored for leaks. If leaking, the item will be removed from the fixture and patched again. Before the item and fixture is transported by cart to the MTV for processing, decontamination of the UPA interior will be performed on equipment, work surfaces and on PPE of the operators. The UPA will have a decontamination kit containing decontaminants, brushes, and absorbent wipes to effect decontamination. A decontamination supply system consisting of supply tanks, a pump, and piping is located on the UPA roof and will be operated by the UPA operators to provide decontamination and rinse waters during decontamination operations. The munition fixture will be attached manually to the CWM item and the assembly placed on the transfer cart and moved to the MMD-1 process trailer.

Load CWM into MTV. The CWM item mounted to the MMD-1 munition fixture will be transported using the munition transport cart to the back doors of the process trailer for loading into the MTV. The CWM item with fixture will be lifted from the transport, cart using a jib crane, onto the fully extended MTV carriage rail. Once loaded onto the carriage, the CWM item will be moved along the carriage into the MTV, using a gearbox that couples the gear rack to redundant electric stepper motors. Once inside the MTV, movement will be remotely controlled and a rotary position transducer and home switch will allow for an accurate indication of the munition's position in the MTV. The MTV hatch will then close and the CWM item will be ready for further positioning and initial cut into the munition body or the DOT container wall.

Position CWM Inside MTV. The CWM item will be moved within the MTV along the carriage rails until properly positioned under the cutting tools. The munition in the fixture can be positioned longitudinally or rotated using the chain drive that couples the munition roller to electric stepper motors. Cutting tools are located in each of the two MTV towers. All positioning operations are performed remotely from the MMD-1 control trailer.

Cut. Once the CWM item is positioned beneath the cutting tool, (either an end-mill or hole saw), the munition clamp will be lowered in place to secure the munition during cutting. The cut will be made by activating the end-mill or hole saw motor and lowering the cutting device to the munition. After the cut is made to the required depth, the end-mill or hole saw motor will be deactivated, the end-mill or hole saw will be raised, and the motor deactivated. Tools are positioned by hydraulic cylinders which allow for an accurate indication of the tool's position in the MTV. The MMD-1 control system will also control the end-mill or hole saw motor speed and direction by valving that modulates the hydraulic fluid flow to the motor. The direction of motor rotation can be changed using a directional control valve. This cut will allow vapor from the CWM item to escape into the MTV.

11.5.2 Chemical Agent or Industrial Chemical Verification

Once the CWM item is cut and vapor is present in the MTV, a vapor sample will be collected and qualitatively analyzed using a process GC/MSD. The results of this analysis will confirm the type of chemical agent or industrial chemical fill. It is anticipated that the sampling collection and analysis activity will occur within 20 minutes of the cut. The results of this verification step will be used to confirm the use of the appropriate NRT work area monitors (MINICAMS[7]) and to select the appropriate reagent for treatment. Additional methods are available for identifying the chemical agent or industrial chemical including MINICAMS[7], Depot Area Air Monitoring System (DAAMS), colorimetric tubes, and the collection and analysis of vapor samples using a sample bomb.

11.5.3 Reagent Preparation

Once the chemical agent or industrial chemical is identified, the appropriate reagent will be identified and prepared. Reagent preparation is an activity common to all chemical agents and industrial chemical treatment procedures. The MMD-1 is capable of preparing reagent from reagent supplies and process water. However, pre-mixed reagents will be used. In order to prepare reagent mixtures, the reagent storage tanks will be filled with water from the process water supply, and then reagent of the specific type and quantity required to treat the chemical agent or industrial chemical will be mixed with the water to form the reagent mixture. When using pre-mixed reagents, the appropriate reagent supply will be selected and prepared into the reagent storage tanks. **Table 11-1** presents the list of chemical agents or industrial chemicals and their corresponding reagents. Once mixed, the reagent will be transferred to the MTV and/or LRV depending on where the chemical agent or industrial chemical will be treated. At a minimum, the quantity of reagent mixed with the chemical agent or industrial chemical will be at a 10:1 volumetric ratio and a 3:1 molar ratio.

Heat Reagent and Transfer Reagent. When treating mustard (H) the reagent will be heated to improve the reaction rate and lessen the time needed to treat chemical agent. The heater on the reagent storage tank and LRV will be used to heat the reaction mixture above ambient temperatures, but below temperatures that could damage MMD-1 equipment.

Heating may occur in the reagent storage tank or the LRV. If heated in the reagent storage tank, the heated reagent is transferred to the MTV and reacted with chemical agent. If heated in the LRV, the reagent is transferred from the reagent storage tank to the LRV, heated, then the heated reagent transferred to the MTV and reacted with chemical agent. Additionally, if heat is needed to continue the improved reaction after the reaction begins in the MTV, the reagent-agent mixture is transferred to the LRV, heated, and recirculated until the reaction is completed.

When GB and VX are treated, the reagent is transferred directly to the MTV unheated and reacted in the MTV.

Prior to treating chemical agents using the heated reagent, the reagent will be recirculated for a period of time prior to cutting and draining the CWM. The recirculation of heated reagent will establish a thermal equilibrium with the treatment equipment, which will help maintain higher temperatures during treatment.

11.5.4 CWM Drain

The munition or DOT cylinder will be rotated to allow the chemical agent or industrial chemical to drain into the bottom of the MTV where it will mix with reagent.

11.5.5 CWM Liquid Treatment. Mixing Reagent and Chemical Agent in Reactor Vessel

The mixing of the chemical agent with reagent will occur in the MTV alone or in the MTV followed by mixing in the LRV.

In the case where mixing occurs in the MTV alone, the treatment reagent and chemical agent or phosgene will be allowed to react until chemical agent concentrations are reduced to levels presented in **Tables 11-2** and **11-3**. The reaction of chemical agent or phosgene and reagent in the MTV is assisted by the mixing of the chemical agent and reagent mixture when it is recirculated through the liquid reactor cooler, the steam condenser/static mixer, and back to the MTV, by the recirculation pumps. The liquid reactor cooler removes heat generated by the exothermic reaction and maintains the mixture temperature within the required range for the chemical agent or phosgene being treated. The mixture is recirculated until the treatment is deemed complete. It is anticipated that treatment may require several hours to several days to meet the treatment performance goals. Treatment effectiveness is determined through sampling and analysis.

To determine if the LRV reagent mixture is strong enough for the next reaction, it is recirculated by the recirculation pumps and sampled. If satisfactory for reuse, it is left in the LRV. Reuse is determined by monoethanolamine (MEA) purity or maintaining a greater than 10:1 volumetric ratio of reagent to agent. Reagent strength will be evaluated at least once, at the end of each munition treatment. Operation procedures will ensure that sufficient reagent will be combined with the chemical agent to avoid causing a saturated solution of carbonates or sulfates. If the MEA purity is insufficient for the next reaction, the reagent will be transferred to the waste surge tanks. If the reagent cannot be reused because chemical agent concentrations are above the treatment level (50 mg/L), additional reagent will be prepared in the reagent storage tank and pumped into the MTV or LRV to treat the reagent. When treatment is deemed complete (as determined by sampling and analysis to 50 mg/L), the MTV or LRV contents will be transferred to the surge tanks.

The mixing of chemical agent and reagent in the MTV followed by mixing in the LRV will be performed for mustard (H) and VX because these reactions require heating to reduce time of treatment. The treatment reaction for mustard (H) and VX is improved by heat. A heated reaction is assured by bringing heated reagent from either the reagent storage tank or LRV into contact with chemical agent/industrial chemical in the MTV. The VX reaction is aided by vigorous mixing when it is recirculated by the recirculation pumps through the liquid reactor cooler, the steam condenser/static mixer, and back to the MTV. If the reaction temperature cools and additional heating is needed, then the chemical agent or phosgene and reagent mixture can be transferred, using nitrogen pressure, to the LRV where it can be combined with reagent, heated and vigorously mixed. Primary mixing of the chemical agent or phosgene and the reagent mixture is accomplished by the recirculation pumps that pump the liquids through the liquid reactor cooler, the steam condenser/static mixer, and back to the LRV. Mixing is also performed in the LRV using the motor-driven agitator.

The LRV reagent mixture is evaluated for reuse as previously described.

11.5.6 Washdown of CWM Residue Remaining on or Inside CWM Item

The treatment of residual chemical agent remaining in the interior of a munition or DOT cylinder after draining will be performed by applying reagent through a high pressure wash to the CWM item interior. The treatment of any chemical agent residues remaining on the exterior of the CWM item container will be treated by spraying reagent through the MTV low pressure banks of sprays.

An alternate method for treating the interior and exterior of a CWM item is to fill the MTV with reagent to a level that submerges the CWM item. Once submerged, the munition body or DOT cylinder will be allowed to soak in the reagent and the reaction allowed to proceed until chemical agent concentrations meet the treatment level of 50 mg/L.

11.5.7 Spray Down MTV Towers with Reagent

Following recirculation of the MTV mixture, the equipment in the tooling towers and the MTV interior is sprayed down with reagent mixture from the reagent storage tank. The reagent fill pumps and the low pressure spray nozzles in the MTV are used to disperse reagent. The spray will decontaminate external portions of the CWM munitions or DOT cylinders and provide a liquid gas contact between the liquid reagent and chemical agent contaminated vapors. This contact Ascrubs@ the vapor of chemical agent contaminates through the chemical reaction between the vapor and the liquid reagent. Liquids generated are transferred to the LRV by the recirculation pumps and recirculated through the LRV, liquid reactor cooler, and static mixer/steam condenser to treat any remaining chemical agent and reduce the temperature resulting from the heat generated during the reaction. The LRV reagent mixture will then be evaluated as previously described.

11.5.8 CWM Gas Treatment

Gas treatment occurs after liquid treatment has been completed. Gases present in the MMD-1 reactor vessels will be treated within the gas and waste gas processing system. Gases discharged from the gas processing system will be treated by the waste gas processing system. The gases will be treated until concentrations of chemical agents are at or below treatment performance level goals presented in **Table 11-3**.

Figure 11-16 shows the gas and waste process system. Gas in the MTV is removed by the process gas vacuum pump and flows through the gas reactor cooler, gas reactor knockout drum and gas reactor prior to storage in the waste gas knockout drum. If sampling of the waste gas knockout drum reveals chemical agent concentration above the performance treatment level goals, the gas is recirculated through the MTV, LRV sparger, gas reactor cooler, gas reactor knockout drum, gas reactor and waste gas knockout drum, by the process gas vacuum pump. As the gas flows through the LRV sparger, the gas bubbles up through the reagent mixture and treats the residual chemical agent or industrial chemical. Gas is then transferred back to the waste gas knockout drum through the gas reactor cooler to reduce the temperature; the gas reactor knockout drum to remove entrained moisture; and the gas reactor to remove remaining trace chemical agent. The gas will be recirculated in this loop until treatment performance level goals are met. Then the gas will be released to the waste gas system for final treatment.

Final treatment of gas involves discharging the gas through the waste gas system, consisting of the waste gas chiller to remove moisture; the waste gas heater to reduce relative humidity; the carbon adsorption unit to remove trace chemical agent or phosgene or treatment reagent; and finally the carbon filtration unit (Ionex) prior to discharge to the Building 3445 carbon filtration system.

Treatment of Phosgene (CG). Two procedures will be used for treating phosgene in the MMD-1 that are based on the quantity of phosgene (CG) to be processed. Quantities are defined as small (less than 1 gallon), and large (greater than 1 gallon). In either procedure, the same treatment reagent is used and treatment occurs in the LRV. The following information describes procedures for treating small and large quantities of phosgene.

The phosgene procedures also contain steps common to the treatment procedures for H, VX and GB. These common steps are: chemical agent or industrial chemical identification, reagent preparation, transfer of liquid wastes to surge tanks, and decontaminating equipment to prepare for treating a new munition or DOT cylinder. Because these steps are common and were previously described, only the unique treatment steps are described herein. Following the preparation of reagent, identification of CG as the fill material, and the cut and drain of CG into the MTV, the reagent is combined with the CG.

Combine Reagent with Large Quantities of CG. Large containers of CG, when treated with reagent, will release large amounts of heat and will require a controlled rate of mixing the CG. Temperatures and pressures in the reactors during treatment will not exceed 330°F at 165 psig for the MTV and 240°F at 180 psig for the LRV. To control the amount of heat generated from treating large quantities of CG, the CG will be slowly injected into the reagent mixture in the LRV using the reagent charge tank and agent injection pump, which is a metering pump capable of supplying CG at very low flow rates. The limiting condition for treating a 500-pound phosgene bomb is the size of the MTV to contain the munition and fixture. The treatment of large phosgene munitions or DOT cylinders in the MTV relies on reacting the phosgene in batches.

Using nitrogen pressure, the CG will be first transferred from the MTV to the reagent charge tank, where the agent injection pump transfers it into the reagent mixture being re-circulated through the LRV, liquid reactor cooler, and static mixer/steam condenser. Nitrogen from the nitrogen generator system is pumped to the MTV to create a differential pressure between the MTV and the reagent charge tank. Appropriate valves will then be opened to allow the flow of liquid chemical agent into the reagent charge tank. The agent injection pump transfers as much liquid chemical agent as practicable from the reagent charge tank into the static mixer/steam condenser. Then the CG and reagent are mixed. When the reagent charge tank is emptied, the process of transferring CG from the MTV to the reagent charge tank and then to the LRV for treatment is repeated, until all the CG in the MTV has been treated. Residual CG in the reagent charge tank is flushed out by transferring reagent mixture from the reagent storage tank to the reagent charge tank. This is accomplished by using the reagent fill pump and then injecting the reagent charge tank liquid into the LRV recirculation loop using the agent injection pump. As the reagent strength in the LRV becomes exhausted, the neutralent is transferred to the surge tanks.

Combine Reagent with Small Quantity CG Munitions or DOT Cylinders. Small containers of CG, when treated with reagent, will also release heat and requires controlling the rate of mixing the CG and reagent to avoid unacceptable increases in temperature and pressures in the reactors during treatment. The treatment of small quantities of CG will be performed on gaseous CG in the gas and waste gas processing systems. Treatment of CG vapors is discussed in the following paragraphs.

The treatment of CG vapors from both large and small quantity CG treatment will be performed in the same manner. However, for small quantities of CG, this is the only treatment performed. For large quantity CG munitions and DOT cylinders, this process is performed in addition to the liquid-liquid reaction performed in the LRV. All CG vapors in the MTV will be treated at a controlled rate in the LRV sparger by using the process gas vacuum pump to recirculate the vapor through first the LRV sparger, then the gas reactor cooler, gas reactor, waste gas knockout drum and then discharged to the waste gas processing system or returned to the MTV.

Liquid samples will be collected from the MTV and LRV. Vapor samples will be collected from the waste gas knockout drum to determine if CG concentration is below the performance treatment level goal. If treatment is deemed complete (at or below treatment performance level goals for chemical agent/industrial chemical) the contents of the waste gas knockout drum are released to the waste gas system for final treatment. Otherwise, recirculation is continued until treatment is complete. Once treatment of CG is considered complete, the vapors in the waste gas knockout drum will be transferred to the waste gas system consisting of the waste gas chiller to remove moisture; waste gas heater to reduce relative humidity; carbon adsorption unit to remove trace industrial chemical or treatment reagent; and finally, the carbon filtration unit (Ionex). Once the vapors are treated, then the MTV tooling tower equipment will be sprayed down with reagent mixture to decontaminate the equipment. Reagent supplied from the reagent storage tanks is sprayed into the MTV using the reagent fill pumps and the two banks of low pressure spray nozzles and spray nozzles in each MTV tower to disperse the reagent.

11.5.9 Decontamination of Equipment

After a munition or DOT cylinder is treated, only the MTV will be decontaminated before a second munition or DOT cylinder containing the same fill is treated. The decontamination procedure is described below. During decontamination, the MTV interior will be flushed with reagent, rinsed with water, and air monitored again. After decontamination, if the MTV interior monitoring results are at or below the concentration limits in **Table 11-3**, the CWM item can be retrieved from the process trailer.

When treatment of the chemical agent or industrial chemical has been satisfactorily completed and the MTV and reagent storage tanks are dry, decontamination of the MMD-1 vessels and piping will be conducted using clean rinse water. Water will be transferred to the reagent storage tanks, recirculated, and pumped to the MTV spray nozzles to clean the tooling tower equipment. The rinse water will then be recirculated in the MTV by the recirculation pumps and the liquid contents will be sampled and analyzed. If analytical results are below the treatment levels of 50 mg/L, the rinse water will be transferred to the surge tanks. If results are unsatisfactory, decontamination of the MTV will be repeated (possibly with reagent combined with rinse water if deemed necessary). If the treatment level of 50 mg/L can=t be reached Dugway will contact the state.

Decontamination liquids in the MTV will be transferred to the surge tanks by nitrogen pressure. Contents in the surge tanks will be recirculated and if sample results are satisfactory (at or below treatment performance level goals for chemical agent/industrial chemical) the contents will be transferred to bulk containers located in the Building 3445 West Chamber (a less than 90 day storage area).

Decontamination of Munition Body. In the event the high pressure wash system does not remove all agent contaminated solid residues from the munition, the munition will be repeatedly cleaned with the high pressure wash until evaluation of the vapor above the munition and visual inspection indicates no agent contaminated solid residues remain inside the munition. This activity is detailed below.

After the munition is cleaned with the high pressure wash, the rinse water may be sampled and analyzed to determine whether performance treatment level goals have been met. If performance treatment level goals have been met, then the rinse water will be transferred to the surge tanks, the MTV and munition body will be rinsed, and a vapor sample of the headspace within the MTV will be collected and analyzed. If agent vapor is detected then it is assumed that agent contaminated solid residues remain inside the munition and the high pressure wash cleaning will be repeated. Following the repeat high pressure wash cleaning, another vapor sample will be collected and analyzed. If results indicate that chemical agent or industrial chemical is not present, then the munition will be removed from the MTV. During the unloading process, the interior of the munition will be visually inspected. If solid residues are observed, the munition will be reloaded into the MTV and cleaned again with the high pressure wash. If agent contaminated solids are still present in the munition, the solids will be returned to the MTV for additional treatment with reagent, or placed into a container and transferred to Igloo G.

Upon completing decontamination activities, the MTV will be vented and the vapor sampled. If satisfactory for opening, the MTV will be opened, the CWM item and fixture removed and loaded on the munition transport cart, and moved to the UPA.

Decontamination of Equipment Between Campaigns. If another munition or DOT cylinder is to be treated that contains a different fill than the previous munition or DOT cylinder, then this is considered a new campaign and different decontamination steps are performed. In this case, the following equipment will be decontaminated prior to treatment operations for the next munition or DOT cylinder: the MTV, reagent storage tanks, LRV, and gas processing and waste gas processing drains. In addition, the surge tanks will be rinsed and drained and the liquid wastes managed as previously discussed.

11.5.10 Solid Waste Disposition

Upon completing decontamination activities, the MTV will be vented and the vapor sampled. If satisfactory for opening (at or below 1.0 TWA), the MTV will be opened, the CWM item and fixture removed and loaded on the munition transport cart, and moved to the UPA. In the UPA, the CWM item and fixture will be separated. DOT cylinders will be containerized and managed as hazardous waste. The F999 munition bodies will be size reduced and abrasive blasted in preparation for shipment offsite to the U.S. Army Rock Island, Illinois, for reclamation.

Solid debris will be manually collected from the MTV and strainers and placed into DOT-approved containers, and managed as hazardous waste.

11.5.11 Neutralent Waste Disposition

Neutralent wastes will be transferred from the MMD-1 equipment to the bulk waste storage containers located in the West Chamber of Building 3445. Waste liquids will be transferred from the MTV, LRV, and surge tanks as described in the paragraphs below.

Transfer MTV Mixture to Surge Tanks. Once the liquid chemical agent/industrial chemicals have reacted and the vapors have been treated in the waste gas processing system, the neutralent will be transferred from the MTV to the surge tanks. Following surge tank sampling and analysis to confirm that chemical agent concentrations are at or below the performance level goals listed in **Table 11-2**, the neutralent in the surge tanks will be transferred to other temporary waste storage containers (350-gallon) in Building 3445 West Chamber.

Transfer LRV Mixture to Surge Tanks. The LRV reagent mixture is recirculated using the recirculation pumps and sampled to determine if the mixture is below performance treatment level goals. If chemical agent concentration is above the performance treatment level goals, additional reagent is prepared in the reagent storage tank and pumped into the LRV to dilute and treat the recirculating mixture. When treatment is complete, as determined by liquid sampling, the LRV contents are transferred to the liquid waste system surge tanks via the waste system.

Discharge Surge Tanks to West Chamber Waste Storage Tanks. The LRV contents will be transferred to the surge tanks using nitrogen pressure in the LRV. These contents will be recirculated and the liquid sampled prior to discharge from the MMD-1 waste system. If the sample is found to be satisfactory, the contents of the surge tanks will be transferred to bulk containers located in the West Chamber less than 90 day storage area. The waste will be transferred via flexible hose from the surge tanks through the East-West Chamber dividing wall, into the West Chamber, and then into the DOT-approved bulk containers. The waste-transfer pump located on the surge tank skid will be used to transfer the waste. If found to be unsatisfactory for release, reagent will be added to the surge tanks for further treatment.

11.6 DETAILED EQUIPMENT DESCRIPTION

This section describes the MMD-1 processing system equipment including components, physical dimensions, and material of construction. The processing systems described are:

- $ Reagent Processing System
- $ Liquid Processing System
- $ Liquid Waste System
- $ Gas Processing System
- $ Waste Gas Processing System
- $ Relief System.

11.6.1 Reagent Processing System

The reagent processing system supplies reagents for use in chemical agent or industrial chemical processing. The system is capable of holding, mixing, heating, and pumping reagents into the liquid processing system. The system is remotely controlled from the control trailer and is supplied with supporting utilities, such as steam, high-pressure wash, nitrogen, hydraulics, electrical power, and instrument air. The system consists of two reagent storage tanks and two reagent fill pumps. A secondary containment pan surrounds each tank to capture any tank or pump leak. Separate secondary containment pans will be provided for. Secondary containment calculations for the reagent storage tank secondary containment pans are provided in
Appendix 11B. Calculations results show that the pans meet secondary containment requirements of containing 100 percent of the largest tank (203 gallons).

The two reagent storage tanks are structurally identical. They will be operated in parallel, and provide backup capacity for each other in the event of a single failure of a tank or its associated components. A schematic of the reagent processing system is presented in **Figure 11-17**. A summary of operating parameters is presented in **Table 11-5**.

The system provides a total of 406 gallons (203 gallons each) of storage capacity for reagents. The tanks are manufactured of carbon steel and are stress-relieved to reduce stress-corrosion cracking common with the reagents used. They are American Society of Mechanical Engineers (ASME)-designed pressure vessels rated for 50 pounds per square inch gauge (psig) and have been determined to be compatible with the reagents and chemical agents/industrial chemicals that will be used in the MMD-1 test. (See MMD-1 Tank Assessment and Installation Certification provided in **Appendix 11C**.)

Each tank includes manual vents, manual drains, access manway, pressure relief valve, remote pressure and temperature indicators, liquid level sight glass, liquid sample collection point, remote level indication, and internal mixer (eductor).

The reagent fill pumps are canned, motor-operated, self-venting centrifugal pumps and have a rated capacity of 38 gallons per minute (gpm) at 105 pounds per square inch (psi). The pumps operate from a common suction header to a common discharge line. Each pump can provide 100 percent of the reagent supply requirements and can be started either locally or by the DCIS in the control trailer.

The reagent processing system will perform several functions, including:

$ Delivering, mixing, and heating prepared reagents to the liquid processing system

$ Storing and delivering liquid wastes (treated residues) from the liquid waste system to the liquid processing system in the event of an other than normal situation.

If the reagent storage tanks are used to store treatment residues, they will be rinsed with clean process water prior to reuse for reagent. Rinsate generated would then be collected in the surge tanks and managed appropriately based on sampling and analytical results.

The reagents will be prepared in the reagent storage tanks or supplied pre-mixed. **Table 11-1** identifies the reagent and associated chemical agents or industrial chemical that will be used in the MMD-1 test. Operators will select reagent after a CWM item content has been verified. To prepare reagent solutions, the bulk reagent will be pumped into the reagent storage tank from the onsite bulk storage area, followed by addition of a diluting liquid (process water). All reagents will be prepared in accordance with established mixing ratios. The reagent storage tank system has inlets for filling the storage tanks with reagents and process water.

Table 11-5. Reagent Processing Design and Operating Parameters

Parameter	Range/Value
Reagent Storage Tanks (A-1.002A/B)	
Capacity - Design	203 gallons each
Low Liquid Level	approximately 57 gallons
High Liquid Level	approximately 175 gallons
Temperature	Ambient to 130°F
Pressure - Design	50 psig at 175°F
Pressure N_2 - Normal Operating	40 psig
Pressure Relief Valve Set Point	50 psig
Material of Construction	Carbon Steel
Heater	19,650 Btu/hr
Reagent Fill Pumps (P-1.001A/B)	
Flow Rate - Design	38 gpm
Motor Power	3 hp

NOTES:
Btu = British thermal unit
°F = degrees Fahrenheit
gpm = gallons per minute
hp = horsepower
psig = pounds per square inch gauge

Reagent mixing occurs when the reagent fill pump recirculates the liquid through the reagent storage tanks and is assisted by the internal mixer (eductor), which facilitates mixing. One reagent storage tank will be equipped with an electric heating jacket that can heat the liquids contained in the tank to 130°F. The reagent fill pumps will also be used during heating to ensure even heating of the liquids.

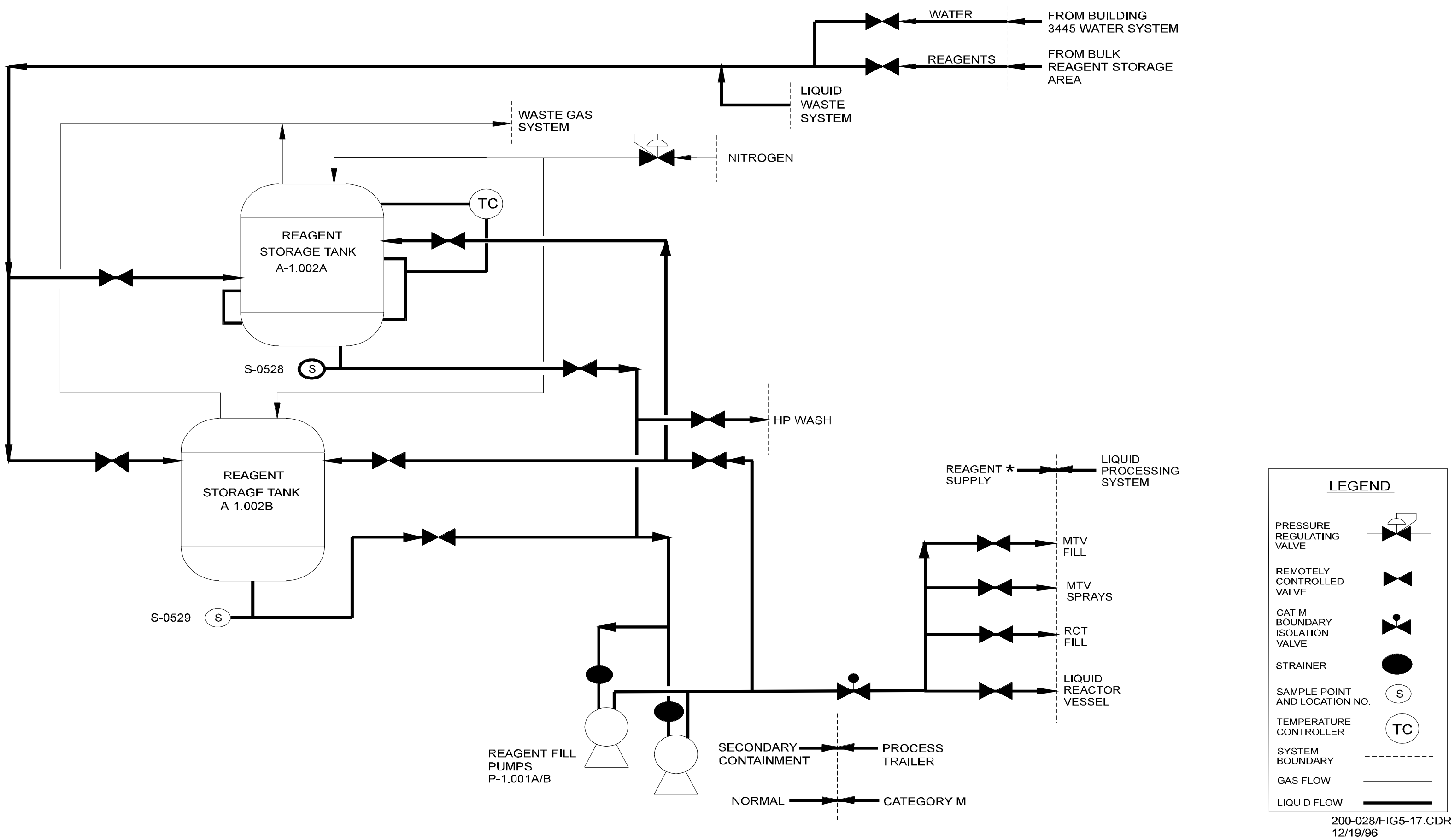

Figure 11-17. Reagent Processing System

Liquids in the reagent storage tanks will be pumped to various locations in the liquid processing system using the reagent fill pumps. The reagent can be pumped to the MTV fill inlet (primary MTV fill method), MTV spray banks (used for gas treatment), LRV, and reagent charge tank, which is a metering tank that can be used to fill the MTV.

The reagent storage tank will be sampled to collect representative liquid samples after the reagent storage tank contents have been sufficiently mixed by the reagent fill pumps. The samples will be collected from the reagent storage tanks on the suction sides of the reagent fill pumps. The liquid samples will be analyzed for reagent strength (MEA purity), chemical agent, or industrial chemical (if liquid wastes are being recycled for treatment), and other parameters as needed.

11.6.2 Liquid Processing System

The liquid processing system will treat chemical agents or industrial chemicals by mixing these chemicals with reagents in a controlled, safe manner to concentrations that are less than or equal to the treatment performance level goals listed in **Table 11-2**. The system consists of several types of equipment, including an LRV equipped with a heater and agitator, an MTV reactor equipped with cutting tools, a liquid reactor cooler, recirculation pumps, agent injection pump, reagent charge tank, and a steam condenser. A schematic of the liquid processing system is presented in **Figure 11-18**. A summary of the liquid processing system operating parameters is presented in **Table 11-6**. The liquid processing system will be housed in the process trailer.

The MTV, LRV, and reagent charge tank materials of construction have been determined to be compatible with the wastes to be stored and treated as described in the MMD-1 Tank Assessment and Installation Certification Report provided in **Appendix 11C**.

11.6.2.1 Munitions Treatment Vessel

The MTV is a 25-inch internal diameter (ID), horizontal cylindrical shell that is 150 inches long and made up of rolled and welded 317L/316L stainless steel plates. The MTV has two vertical towers that are 25 inches ID and 70 inches high that contain the cutting tools (saws) used to breach CWM items or DOT containers. The MTV towers also contain high pressure wands that will be used to rinse the content fill of a CWM item. One wand is located in each MTV tower, and each wand contains a high pressure nozzle. Each wand is a 0.821-inch diameter pipe fitted with a rotating spray nozzle and is capable of being lowered through the opening in the munition body.

Once lowered, hot water or reagent can be delivered through the wand spray nozzle at a rate of 3 gallons per minute at 10,000 pounds per square inch to dislodge solid residues inside the munition body. Only one wand will be used at a time. The MTV has four access hatches: one at each end of the vessel and one on each tower to access tools during repairs and maintenance.

Operations within the MTV will be monitored by four video cameras, two mounted in each tower. The CWM cutting area will be within the camera field of vision. Available equipment arrangement drawings for the MTV are listed in **Appendix 11A**.

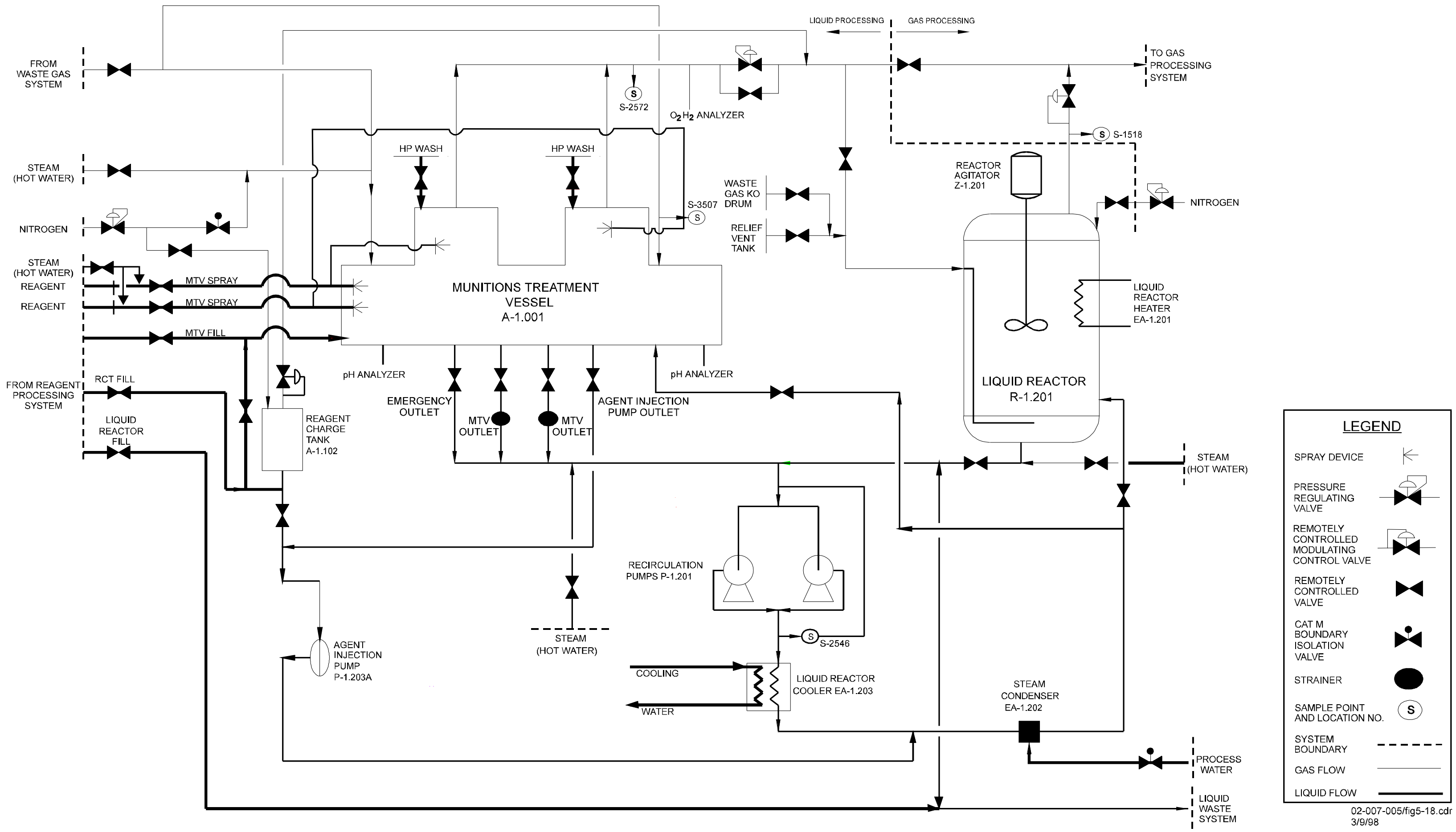

Figure 11-18. Liquid Processing System

Table 11-6. Liquid Processing Design and Operating Summary

Parameter	Range/Value
MTV (A-1.001)	
Capacity - design	280 gallons
Low liquid level	approximately 23 gallons
High liquid level	approximately 265 gallons
Temperature	Ambient to 130°F
Pressure - design	165 psig at 330°F
Pressure N_2 - normal	5 to 75 psig
Pressure relief valve setpoint	165 psig
Materials of construction	317L/316L stainless steel
Recirculation Pumps (P-1.201A/B)	
Flow rate	90 gpm
Motor power	5.5 hp
Agent Injection Pump	
Flow rate	2.6 gpm
Motor power	2 hp
LRV (R-1.201)	
Capacity - design	375 gallons
Low liquid level	approximately 170 gallons
High liquid level	approximately 345 gallons
Temperature	Ambient to 130°F
Pressure - design	180 psig at 240°F
Pressure N_2 - normal	20 to 85 psig
Pressure relief valve setpoint	180 psig
Materials of construction	316L stainless steel
Recirculation	
Recirculation pumps	
Reagent Charge Tank	
Capacity - design	24 gallons
Pressure - design	165 psig
Relief valve setpoint	165 psig
Materials of construction	316L stainless steel
Liquid Reactor Agitator (Z-1.201)	
Motor power	1 hp
Liquid Reactor Heater (EA-1.201)	
Heat load	68,000 Btu/hr
Steam Condenser/Static Mixer (EA-1.202)	
Heat load	190,000 Btu/hr
Flow rate	3 gpm
Liquid Reactor Cooler (EA-1.203)	
Heat load	45,000 Btu/hr
Flow rate	90 gpm

NOTES:
Btu = British thermal unit
°F = degree Fahrenheit
gpm = gallons per minute
hp = horse power
N_2 = Nitrogen
psig = pounds per square inch, gauge

The MTV meets ASME Boiler and Pressure Vessel Code Section VIII, Division 1, pressure vessel code requirements and is certified for lethal service. The MTV is constructed of 317L/316L stainless steel and has a working capacity of approximately 265 gallons (design capacity is 280 gallons). The MTV is designed and pressure-certified for 165 psig at 330°F, although its normal operating pressure is below 75 psig. A pressure relief device is provided that vents to the relief system (as discussed in Section 5.6.7) if pressures exceed 165 psig. The design temperature of the MTV is 330°F.

The tower tools and the munition positioning system (carriage) are the moving mechanical systems inside the MTV used to position and breach the CWM munition or DOT container. Each MTV tower has equipment capable of clamping the CWM munition or DOT container down, cutting into the CWM munition or DOT container, and spraying fluids (reagent or water) at high pressure (5,000 psi) into the breached CWM munition or DOT container. A 100-psi spray of steam also can be directed into the breached CWM munition or DOT container. The tools and positioning devices are powered by hydraulic and electric motors, and are controlled by the MMD-1 control room operator through the DCIS.

The CWM item or DOT cylinder is positioned under either tower by the carriage assembly. The CWM item or DOT cylinder is loaded onto the carriage outside the MTV. The carriage slides back into the MTV and is positioned under either tower by remote control commands from the MMD-1 control room DCIS interface. The carriage is instrumented with a home switch that resets the positioner and the linear position of the carriage. The home indication is electronically transmitted to the MMD-1 control room operator through the control system. The CWM munition or DOT container can be rotated on the carriage rollers so that a cut can be made into the sides of the CWM munition or DOT container. CWM munition or DOT container rotation is also powered by an electric motor so that degrees of rotation can be translated to the MMD-1 control room operator through the DCIS, thus positioning the CWM munition or DOT container in the desired location for cutting.

The MTV tower tools (end-mill or hole saw) in each tower are used for breaching and cutting the CWM items or DOT cylinder. They are mounted onto hydraulically powered cylinders and are instrumented to provide information to the operator on their position or to indicate trouble. Cylinders that are sensitive to position are instrumented with a position feedback. The clamp is controlled by observing hydraulic fluid pressure levels. The end-mill or hole saw motor is hydraulically powered.

Process connections to the MTV include spray nozzles, reagent fill, nitrogen supply, electrical connectors, hydraulic hose connections, and instrumentation. Also included is the MTV spray system, consisting of 48 fixed spray nozzles [30 located in the main shell (15 per each side of the vessel) and 18 located in the towers (9 per tower)]. The spray system will scrub vapors and decontaminate external portions of CWM munitions or DOT containers.

The MTV is instrumented with three remote temperature sensors, two pressure sensors, and a liquid sample connection. The vapors inside the MTV are monitored for chemicaagent by an in-line GC/MSD and an NRT monitoring system. The MTVcontains liquid level transmitters and a local sight glass. The high-level alarm switch for the MTV is set at 20.5 inches (approximately 265 gallons). These indications and alarms are remotely indicated in the MMD-1 control room.

Liquid in the MTV can be recirculated using recirculation pumps. Liquids may be withdrawn from the MTV by way of three outlets: MTV outlet, MTV outlet to the injection pump suction, and emergency outlet.

The MTV outlet is the principal means for draining the MTV of liquid. Liquids that drain through the MTV outlet can be recirculated to the MTV. The flow from the MTV outlet passes through a coarse strainer located in the bottom of the MTV and magnetic strainers located in the process piping. There are two magnetic strainers (one each in two parallel pipes) that provide 100 percent redundancy in the event one strainer becomes plugged.

The emergency outlet is used when the MTV outlet has been plugged by debris. Once liquids are removed through the emergency outlet, the liquids will be sent to the LRV via the recirculation pumps.

The agent injection pump is used to remove as much liquid as possible from the reagent charge tank. The agent injection pump is then used to pump the chemical agent into the recirculation loop at the steam condenser/static mixer. Recirculated liquids are returned to the MTV through four inlets that are located along the bottom of the vessel.

11.6.2.2 Liquid Reactor Vessel

The LRV is one of the two batch reactor vessels in the liquid processing system in which the chemical agents or industrial chemicals that are drained from CWM munitions or DOT containers can be reacted with reagent. The primary function of the LRV is to treat the gaseous emissions generated from the MTV and to treat low vapor pressure chemical agents or industrial chemicals (for example, phosgene).

The LRV has a capacity of 375 gallons and is constructed of 316L stainless steel. The LRV is an ASME, Section VIII, Division 1, Lethal Service Vessel, is 4 feet in diameter with a 4-foot, 1-inch straight side wall, and is rated for 180 psig at 240°F. Its relief device is set at 180 psig. The insulated vessel is heated by the liquid reactor heater when required. The heater provides 68,000 Btu/hr and is automatically cycled on at 100°F and off at 160°F of the process fluid when the LRV is in use. The heater is de-energized if a low liquid level is detected in the LRV.

The LRV is equipped with a motor-driven agitator (liquid reactor agitator), a sparger for waste gas injection, an access way, manual vent, and drain fittings. The LRV is instrumented with a liquid level indicator, high-high level switch, and remote temperature and pressure sensors.

11.6.2.3 Recirculation

The liquid processing system provides recirculation, mixing, and temperature modulation through recirculation pumps, the liquid reactor cooler, and the steam condenser.

- *Recirculation Pumps.* The two recirculation pumps are centrifugal, canned, motor pumps rated at 90 gpm; each has a 5.5-hp motor. The recirculation pumps are redundant and operate in parallel to provide backup capacity for each other in the event of a single failure. Each pump provides 100 percent of the system flow requirements. The pumps are instrumented with local and remote suction and discharge pressure indicators and are monitored for differential pressure. They can be started and stopped from the control room with the DCIS. They are automatically stopped in the event of a low-low liquid level sensed in either the MTV or the LRV. Each pump is provided with a manual casing drain valve and discharge check valve. The pumps are capable of pumping dry. The pump motor cans are separated from process liquids by an internal mechanical seal. A barrier fluid, cooled separately, prevents overheating.

$ *Liquid Reactor Cooler.* The liquid reactor cooler provides intermittent process cooling if required by LRV or MTV liquid temperatures. The cooler is designed to slowly cool the reaction products. The component is a countercurrent, single-pass, double-tube heat exchanger constructed of 316L stainless steel and rated at 245 psig at 240°F. The supply of chilled water to this unit is controlled by the DCIS; when cooling is not needed, the supply is turned off. The liquid inlet and outlet temperature, flow, and pressure are indicated remotely by the DCIS. Relief valves on the process liquid side of the cooler are set at 220 psig and on the water side of the cooler, at 150 psig. A rotameter flow instrument with a valve is installed in the cooling water discharge to adjust cooling water flow.

$ *Steam Condenser/Static Mixer.* The steam condenser/static mixer is a direct-contact heat exchanger that condenses clean-out steam used during the high pressure wash when necessary. It is connected with process water to condense steam that is only used during clean-out operations. The steam condenser/static mixer contains baffles that aid in mixing recirculated fluids and is used to mix the fluids pumped from the agent injection pumps. The steam condenser/static mixer is constructed of 316L stainless steel and is rated at 245 psig at 240°F.

11.6.2.4 Reagent Charge/Agent Injection

The reagent charge and agent injection components of the liquid processing system process low vapor pressure chemical agents or industrial chemicals. Liquid chemical agents or industrial chemicals will be transferred from the MTV to the reagent charge tank using nitrogen pressure to create a differential pressure to allow the flow of liquid into the reagent charge tank. Liquids are then pumped from the reagent charge tank by the agent injection pump, which meters the chemical agents or industrial chemicals into the LRV recirculation loop for treatment.

The reagent charge tank is constructed of 316L stainless steel and has a capacity of 24 gallons. It is an ASME, Section VIII, Division 1, Lethal Service Vessel, pressure-rated for 165 psig at 330°F. A relief device set at 165 psig is connected to the relief vent tank (Section 11.2.9). The tank pressure and level are indicated remotely through the DCIS. A high-level switch provides a redundant signal to stop tank filling operations and prevent the tank from overflowing. A sight glass also provides local level indication.

The primary function of the agent injection pump is to inject chemical agent at a controlled rate from the reagent charge tank into the LRV through the steam condenser. The pump is a diaphragm metering pump rated at 2.6 gpm. The pump receives fluids from a common header that can be lined up to the reagent charge tank or the MTV and discharged to the steam condenser in the LRV recirculation flow path. The pump is automatically stopped in the event a discharge pressure of 180 psig or higher is sensed in the pump discharge line. The pump is provided with a manual drain and discharge check valve. Pump performance is monitored with remote indications of pump discharge pressure, pump differential pressure, and flow in the common discharge header. The pump diaphragm is a dual diaphragm with a leak detection system.

11.6.3 High Pressure Wash System

A high pressure wash system removes residual material from inside the CWM munition or DOT container casing. The system consists of a high pressure wash pump and associated piping and connects to a steam utility line. A schematic of the high pressure wash system is presented in **Figure 11-19**. The system is capable of pumping water or reagent to the high pressure spray nozzles within the MTV towers. The high pressure pump takes suction off the reagent storage tanks.

The high pressure wash pump is a positive displacement pump capable of delivering 3 gpm at 5,000 psig to the downstream high pressure nozzle inside the MTV. The pump is a self-contained, skid-mounted unit located adjacent to the process trailer. The pump suction pressure, discharge pressure, and temperature are monitored with remote and local indicators.

11.6.4 Liquid Waste System

The liquid waste system holds liquid wastes generated from the liquid process (neutralents, rinse waters), gas process condensate, and waste gas process condensate. A waste transfer pump transfers the liquid wastes to DOT containers. The liquid wastes generated include neutralent spent reagents, knockout drum liquids, and liquids that are discharged to the process trailer sump, including condensate from HVAC, and waste gas cooler.

The liquid waste system consists of two surge tanks, a waste transfer pump (located adjacent to the process trailer), and the trailer sump pump (located in the process trailer sump). A schematic of the liquid waste system is presented in **Figure 11-20**. A summary of the operating parameters is presented in **Table 11-7**. Liquid wastes (for example, neutralents, rinse waters, and condensate) in the surge tanks can be pumped to the DOT bulk containers located in the Building 3445 West Chamber, or back to the reagent processing system for retreatment as necessary. Each surge tank is constructed of 316L stainless steel and has a 203-gallon design capacity with a 175-gallon operating capacity. Each tank contains local and remote pressure and temperature sensors, a level indicator, a level transmitter (for alarms), and an access way for inspection and cleaning, and will be surrounded by a secondary containment pan to contain spills. The waste transfer pump is equipped with a 5.5-hp motor and can pump 34 gpm at 45 psi. This pump is provided with a barrier fluid reservoir to prevent the motor from overheating.

The surge tanks have been determined to be compatible with the waste streams to be stored and managed as described in the MMD-1 Tank Assessment and Installation Certification Report provided in **Appendix 11C**.

A secondary containment pan will provide secondary containment for the liquid waste surge tanks that will be located outside the process trailer, inside Building 3445. The secondary containment pan measures 6 feet wide by 7 feet long by 1 foot deep and is made of fiberglass. Each surge tank has a capacity of 203 gallons and is operated at this volume. Secondary containment calculations for the secondary containment pan are provided in **Appendix 11B**. Calculation results show that the pans meet secondary containment requirements for containing 100 percent of the largest tank (203 gallons).

The process trailer sump will be serviced by a sump pump to remove liquid wastes that may have accumulated in the process trailer=s secondary containment pan as a result of leaks from piping, pumps, vessels, or miscellaneous process drains. The remotely controlled pump is located in the sump in the trailer floor and discharges through a remotely operated valve to the LRV or the surge tanks. The process trailer sump pump is equipped with a 2-hp motor that can pump at 8 gpm.

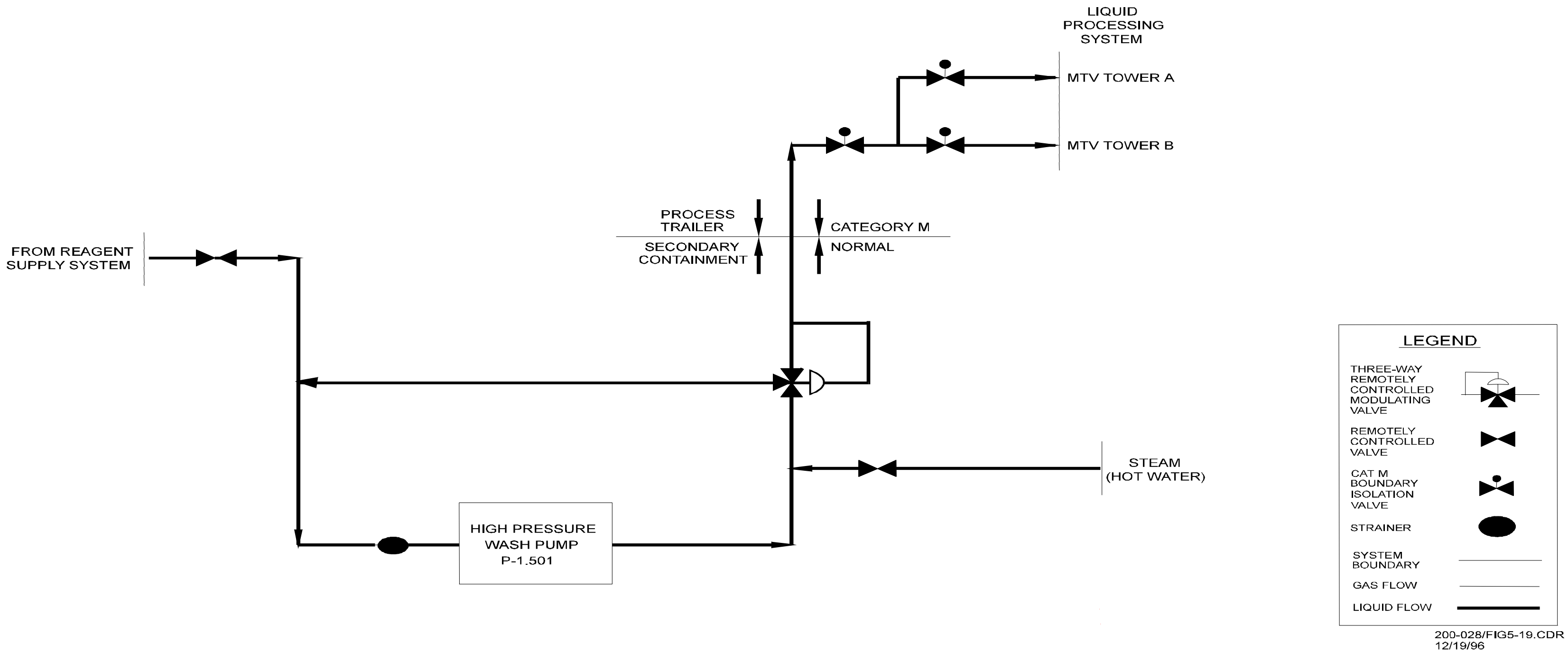

Figure 11-19. High Pressure Wash System

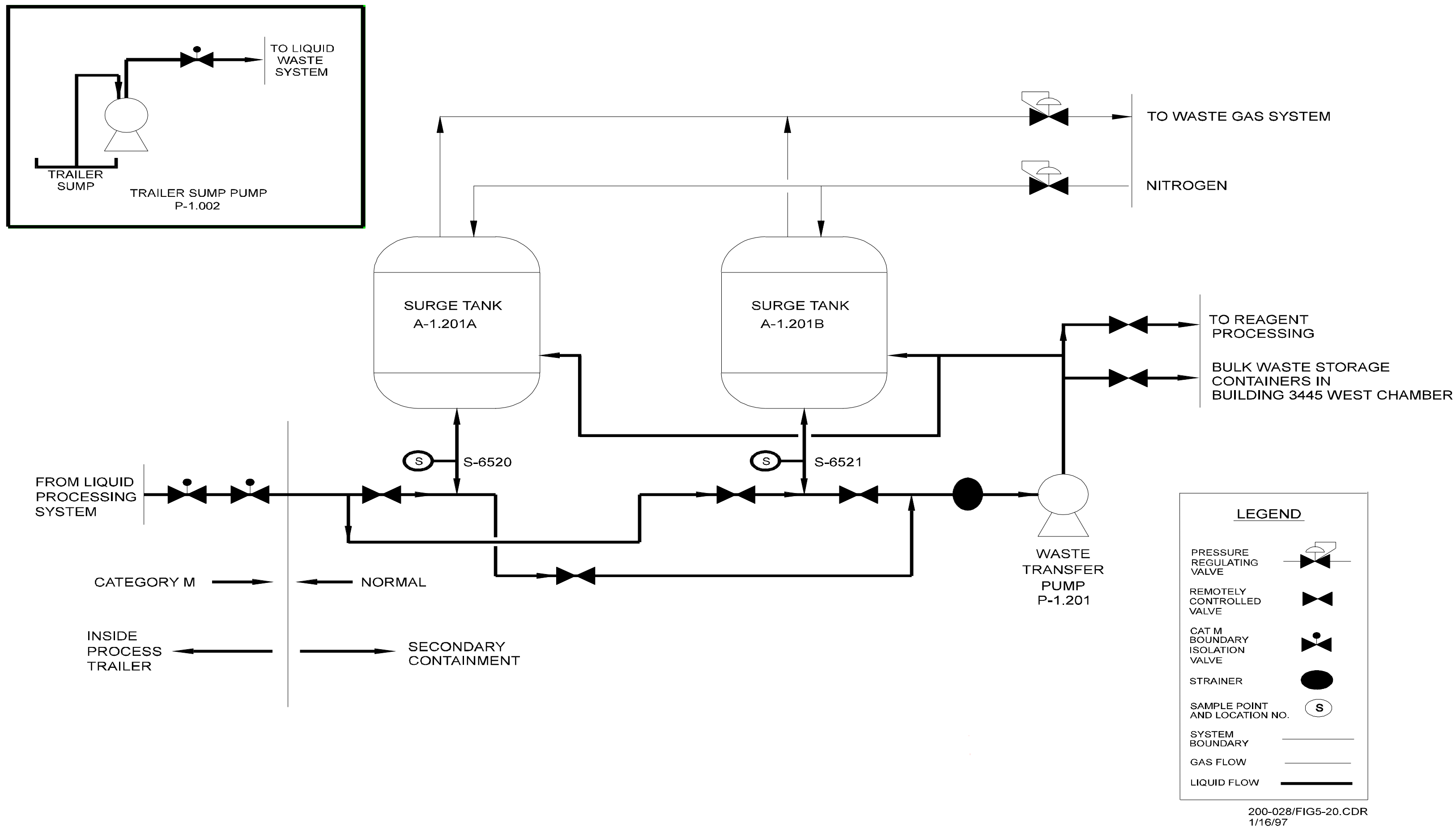

Figure 11-20. Liquid Waste System

Table 11-7. Liquid Waste System Design and Operating Summary

Parameter	Range/Value
Surge Tanks (A-1.201A/B)	
Capacity - design	203 gallons each
Low liquid level	approximately 55 gallons
High liquid level	approximately 175 gallons
Temperature	Ambient to 130°F
Pressure - design	180 psig at 190°F
Pressure N_2 - design	5 psig
Pressure relief valve setpoint	180 psig
Material of construction	316L stainless steel
Waste Transfer Pump (P-1.2.2)	
Flow rate - design	34 gpm
Motor power	5.5 hp
Process Trailer Sump Pump (P-1.002)	
Flow rate - design	8 gpm
Motor power	2 hp

NOTES:
°F = degrees Fahrenheit
gpm = gallons per minute
hp = horse power
psig = pounds per square inch gauge

Any residual liquids in the containment sump will be removed by either pumping the liquids out of the containment sump using a portable centrifugal pump or absorbed using a compatible absorbent material, such as granules, pillows, sheets, or sacks.

The surge tanks will vent to the waste gas system in the process trailer when pressures exceed 180 psig inside the tanks. The vapors are then treated and vented to the inlet of the Building 3445 carbon filtration system.

The surge tanks are monitored for high and low liquid levels, temperature, and pressure. The DCIS design incorporates operator observation of process values, alarms, trips, and interlocks in the liquid waste system operation. A general discussion of process monitoring is presented in Section 11.7.

11.6.5 Gas Processing System

The gas processing system will be located in the process trailer and will pump and treat chemical agents or industrial chemical vapors from the MTV, LRV, and reagent charge tanks. The gas processing system consists of a process gas vacuum pump, gas reactor cooler, gas reactor knockout drum, gas reactor, and waste gas knockout drum. A schematic of the gas processing system is presented in **Figure 11-21**. Treatment of vapors will also be performed in the MTV and LRV, as described below. A summary of the operating parameters is presented in **Table 11-8**. The gas processing system may be operated continuously or intermittently during treatment. Intermittent operation may be appropriate when gas pressures in the MTV, LRV, and waste gas knockout drum are well below the operating ranges. In those cases, gas processing occurs at the end of the CWM munition or DOT container treatment process, just before the MTV is rinsed and drained to the liquid waste system.

The gas processing system uses Category M piping. A more detailed discussion of Category M piping is presented in Section 11.6.8. The DCIS design incorporates operator observation of process values, alarms, trips, and interlocks in the gas processing system.

11.6.5.1 Process Gas Vacuum Pump

The process gas vacuum pump, which is rated at 5 actual cubic feet per minute (acfm), will compress gas from the vapor space of the MTV and LRV and discharge the gas at up to 150 psig into the gas reactor knockout drum. The vacuum pump is a motor-driven, diaphragm compressor that is located in the process trailer and can be remotely controlled with the DCIS.

The vacuum pump has a triple-layer diaphragm with a leak detection capability to identify a ruptured diaphragm layer. Vacuum pump performance is measured from the inlet and discharge pressures and temperatures. The vacuum pump has a suction strainer and an internal pressure relief valve to protect the pump from overpressure. Differential pressure across the suction strainer will be monitored to identify clogged conditions.

11.6.5.2 Gas Reactor Cooler

The gas reactor cooler is a double-pipe heat exchanger that will adjust the temperature and humidity of the gases discharged from the vacuum pump by removing the heat approximately equal to the adiabatic heat of compression. Cooling water will be supplied by the HVAC chiller. Gas inlet and outlet temperatures and the cooling water inlet and outlet temperatures will be monitored remotely by the DCIS. The cooling water flow will be adjusted by a variable area flow instrument and valve at the cooling water discharge.

11.6.5.3 Gas Reactor Knockout Drum

The gas reactor knockout drum will remove entrained moisture droplets from the gas streams discharged from the gas reactor cooler to reduce moisture content of the vapor stream entering the gas reactor. The drum is a 4-inch standard wall pipe section of 316L stainless steel that is 3 feet, 9 inches long, and terminated at both ends with flanged heads. The knockout drum has a 2.5-gallon capacity and is equipped with a relief valve, a manual vent to the process trailer, a manual drain fitting, and instruments for remote monitoring of temperature, pressure, and liquid level. A local sight glass is provided for local liquid level indication. Liquids that accumulate in the gas reactor knockout drum will be manually drained into the LRV for treatment and discharge to the liquid waste system.

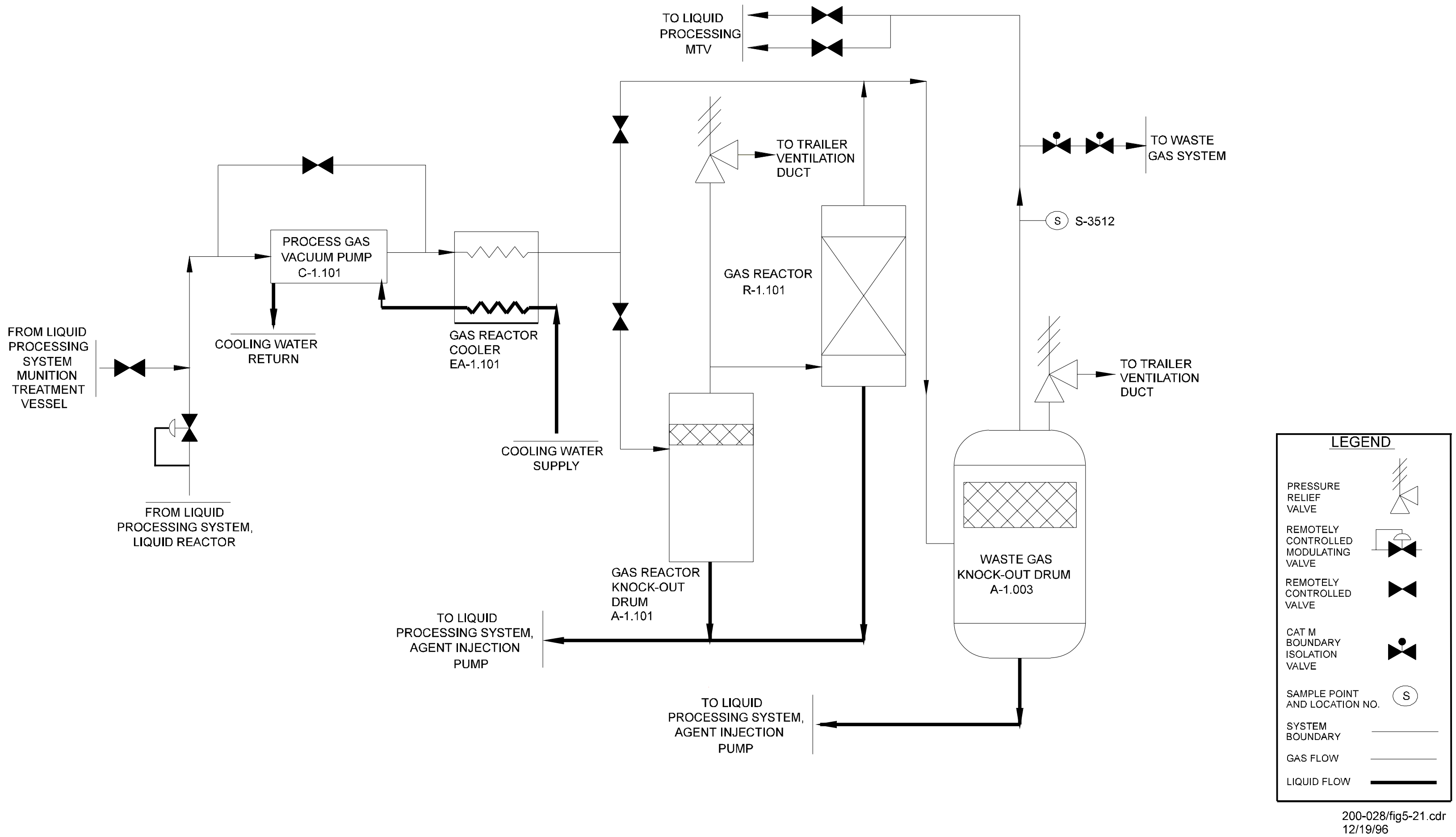

Figure 11-21. Gas Processing System

Table 11-8. Gas Processing Design and Operating Summary

Parameter	Range/Value
Gas ReactorKnockout Drum (A-1.101)	
Capacity - design	2.5 gallons
Low liquid level	empty
High liquid level	0.32 gallons
Flow rate	5 acfm
Pressure - design	180 psig at 200°F
Relief system	180 psig
Process Gas Vacuum Pump (C-1.101)	
Flow rate	5 acfm
Motor power	7.5 hp
Gas Reactor Cooler (EA-1.101)	
Flow rate	5 acfm
Heat load	5,500 Btu/hr
Gas Reactor (R-1.101)	
Capacity	13 gallons
Pressure - design	180 psig at 210°F
Flow rate	5 acfm
Carbon - capacity	9.1 gallons
Carbon - type	activated, impregnated with 20 percent NaOH, 4x10 mesh TIGG Corporation type HSS
Carbon - density	37.4 lb/ft^3
Waste Gas Knockout Drum (A-1.003)	
Capacity	70 gallons
Low liquid level	empty
High liquid level	7.5 gallons
Flow rate	5 acfm
Pressure - design	180 psig at 150°F
Pressure relief device set point	180 psig

NOTES:
acfm = actual cubic feet per minute
Btu = British thermal unit
°F = degrees Fahrenheit
hp = horsepower
psig = pounds per square inch gauge

11.6.5.4 Gas Reactor

The gas reactor, which will treat the vapors discharged from the gas reactor knockout drum, is an 8-inch standard wall pipe section of 316L stainless steel that is 5 feet long and terminated at both ends with flanged heads. The gas reactor has a capacity of 13 gallons. The reactor contains a packed bed of activated carbon impregnated with sodium hydroxide (NaOH) that reacts with residual chemical agents or industrial chemicals in the gas stream. The packed bed is held in place by a wire screen. The packed bed will be manually removed through the top flange and replaced when the NaOH is spent. Replacement of the carbon will occur when the sodium hydroxide that is impregnated onto the activated carbon becomes exhausted. Sodium hydroxide will be determined to be exhausted by continuously monitoring temperature at intermediate points in the packed bed of sodium hydroxide impregnated carbon bed and downstream of the gas reactor. When excessive heat of reaction is detected, as determined by a downstream temperature above 200 degree F, it will indicate a need to change out the carbon. The treated vapor stream will discharge to the waste gas knockout drum. Liquids that accumulate in the gas reactor will be detected by a liquid level switch located near the bottom of the reactor. A manual drain to the LRV drains any accumulated water to the liquid waste system.

11.6.5.5 Waste Gas Knockout Drum

The waste gas knockout drum provides a capability for discharging the vapors for final treatment in the waste gas processing system or returning it to the MTV. The waste gas knockout drum is a cylinder with a 20-inch outside diameter (OD) and a length of 4 feet, 7.5 inches made of 316L stainless steel and designed for 180 psig. The drum separates entrained moisture in the vapor stream that has been discharged from the gas reactor by using installed moisture separators. Vapor is normally stored under pressure, sampled, analyzed, and discharged to the waste gas processing system or recirculated in the gas processing system.

11.6.6 Waste Gas System

The waste gas system consists of the vent knockout drum, waste gas knockout drum, waste gas heater and carbon adsorption unit (canisters). The waste gas system provides a final treatment of chemical agent or industrial chemical vapors prior to exhausting the vapors into the process trailer carbon system filter. A schematic of the waste gas system is presented on **Figure 11-22**. The waste gas system will be located in the process trailer and will perform the following functions:

- Remove moisture and volatile organic chemicals that remain in the vapors from the gas processing system (a process known as gas polishing)

- Clean and polish nitrogen gas in the vapor headspace of the reagent storage tanks and surge tanks.

A summary of the waste gas system operating parameters is presented in **Table 11-9**.

11.6.6.1 Vent Knockout Drum

The vent knockout drum removes entrained moisture by means of a reduction in gas velocity from vapors present in the reagent storage tanks (reagent processing system) and the surge tanks (liquid waste system). It consists of a 2-foot long, 3-inch diameter 316L stainless steel pipe, rated at 35 psig, and is terminated at both ends by a flanged joint. A high level switch in the drum warns operators of potential high liquid levels in the reagent or liquid waste storage tanks. Vapors from the vent knockout drum are discharged to the waste gas chiller.

11.6.6.2 Waste Gas Chiller

The waste gas chiller condenses water and hydrocarbons from the vapor stream discharged from the gas processing system's waste gas knockout drum and the vent knockout drum. It is a single-pass, countercurrent shell and tube heat exchanger constructed of carbon steel and designed to 150 psig on the tube side. Moisture removed from the vapor stream is collected and drained to the trailer via a gas/liquid separator. The cooling water flow will be adjusted by a variable area flow instrument and valve at the cooling water discharge.

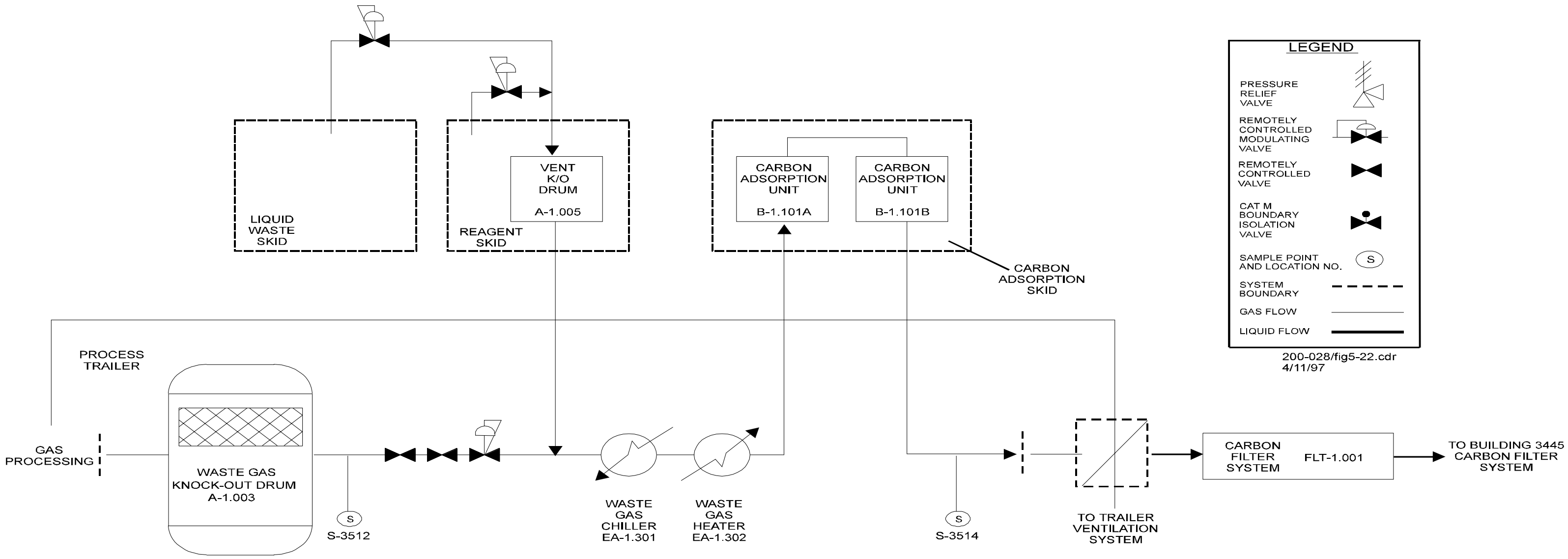

Figure 11-22. Waste Gas System

Table 11-9. Waste Gas System Design and Operating Summary

Parameter	Range/Value
Carbon Adsorption Unit (B-1.101A)	
Pressure - design	15 psig @ 350^{N}F
Flow rate	50 cfm
Carbon - capacity	240 lbs
Carbon - type	activated, impregnated per MIL-C 13724D Grade III, Whetlerized, 12x30 mesh
Carbon - density	39.3 lb/ft^3
Carbon Adsorption Unit (B-1.101B)	
Pressure - design	10 psig @ 350^{N}F
Flow rate	50 cfm
Carbon - capacity	250 lbs
Carbon - type	activated, impregnated with 10 percent phosphoricacid, 4X10 mesh, TIGG Corporation type HP
Carbon - density	37.4 lb/ft^3
Waste Gas Chiller (EA-1.301)	
Heat load	4,000 Btu/hr
Waste Gas Heater (EA-1.302)	
Heat load	1,200 Btu/hr
Process Trailer	
Carbon Filter (FLT-1.001)	
Flow rate	500 cfm
Pressure - design	10 inch w.g.
Flow configuration	Inlet damper/prefilter/HEPA/charcoal/charcoal/HEPA/Fan
Prefilter - particulate removalefficiency	35 percent (ASHRAE), medium efficiency
HEPA filters - particle removalefficiency	Hi efficiency, 99.97 percent removalof 0.3 micron particulates
Carbon adsorber tray	Type II tray 5, 2 per bank,2 banks in series, total 4 trays
Carbon adsorber - thickness of bed	2 inches per bank, total 4
Carbon adsorber - residence time	0.33 sec/bank @ 500 cfm,total .66 sec
Process Trailer	
Carbon Filter (FLT-1.001) Continued	
Carbon adsorber - type	Activated, impregnated per MIL-C-13724D Grade IV,Whetlerized, 12x30 mesh
Carbon adsorber - density	0.63 gm/mL
Carbon breakthough[a] (estimated)	238 hours
Fan static pressure	10 inches w.g. @ 500 cfm
Fan motor power	2 HP each (2 motors)
System design standard	ANSI N509
Vent Knockout Drum (A-1.005)	
Capacity	0.8 gallons
Pressure	35 psig at 190^{N}F

NOTES:

a **Appendix 11D** presents the carbon breakthrough time calculation.

ANSI	=	American National Standards Institute
ASHRAE	=	American Society of Heating, Refrigeration, and Air Conditioning Engineers
Btu	=	British thermal unit
cfm	=	cubic feet per minute
F	=	degrees Fahrenheit
gm/mL	=	gram per milliliter
HP	=	horsepower
lbs	=	pounds
MIL	=	military
psig	=	pounds per square inch gauge
w.g.	=	water gauge

11.6.6.3 Waste Gas Heater

The waste gas heater uses process steam heat to lower the relative humidity of the waste gas stream to 80 percent or less. This heater conditions the vapor waste steam for treatment by the carbon adsorption unit. The waste gas heater is a single-pass, countercurrent, carbon steel, double-pipe heat exchanger rated at 125 psig on the tube side.

11.6.6.4 Carbon Adsorption Unit

The carbon adsorption unit will remove trace quantities of MEA, ammonia, or methyl alcohol, and any residual traces of chemical agents or industrial chemicals from vapors before venting into the process trailer HVAC system. The carbon adsorption unit has an operating flow rate of 50 cfm and consists of two activated carbon-filled 55-gallon carbon steel canisters in series. One canister has an activated carbon bed that is specific to ammonia, and the other canister has an activated carbon bed that is specific to chemical agents or industrial chemicals. The carbon adsorption unit will treat vapor streams discharged from the waste gas heater. The waste gas stream is discharged to the process trailer carbon filter system, which vents to Building 3445. The Building 3445 East Chamber activated carbon filter system provides an additional safeguard to remove any constituents before the vapor is released outside Building 3445.

11.6.6.5 Process Trailer Carbon Filter

The process trailer carbon filter unit removes potential airborne agent contaminants released from the gas processing systems by operator action, by relief valve or control valve venting due to overpressurization of the process system, or by system leakage into the process trailer.

The carbon filter unit contains a modulating flow control damper, a filter housing containing a pre-filter, HEPA filter, two HEGA filter banks in series, another HEPA filter, and an exhaust fan powered by two redundant, independent motors. The exhaust fan, in conjunction with the modulating damper, maintains a constant flow rate of 500 cfm through the carbon filter unit with the filters in a clean or dirty condition. The filter unit draws air from the process trailer through a fire damper. The process trailer is maintained at 0.25 inches of water negative pressure relative to Building 3445 by manually throttling the trailer air intake damper to ensure no air leakage into Building 3445. Operator controlled releases from the waste gas system and relief valve and control valve releases discharge directly into the carbon filter unit inlet duct. The carbon filter unit discharges into the Building 3445 exhaust duct to allow the air to be treated by the building carbon filter units prior to release to the environment.

The pre-filter is designed to remove large particulate matter from the air stream prior to reaching the downstream HEPA filter. The upstream HEPA filter protects the HEGA filters from particulate matter and the downstream HEPA traps any carbon fines which escape from the HEGA filters. Pre-filters and HEPA filters are replaced when the pressure drop across individual filters exceeds established criteria. The HEPA filters will remove 99.97 percent of particulate matter down to 0.3 microns in size.

Each HEGA filter bank contains two, Type II tray-type cells. Each cell contains two, 2-inch deep trays filled with two inches of activated, impregnated charcoal. The cells are mounted in the filter housing with the trays in a horizontal position so that air flows vertically through the four carbon filled trays simultaneously (in parallel) whereas the overall flow through the filter housing is horizontal. The two HEGA banks in series provide a total carbon thickness of 4 inches.

The HEGA filters are activated carbon, impregnated with copper, silver and chromium (Whetlerized) to improve adsorption of highly volatile compounds such as phosgene. The HEGA filters are replaced when carbon filter performance deteriorates to the point where agent breakthrough of the carbon bed occurs. DAAMS is used to monitor the agent concentration between the two HEGA banks and when agent concentration above the 1.0 TWA level is detected, carbon in both filter banks will be replaced.

All filters (pre-filter, HEPA, HEGA) in the process trailer carbon filter unit are of the bag in/bag type which allows filters to be replaced from the exterior of the filter housing without exposing personnel to the contents of the spent filters. Plastic bags surrounding the access openings encapsulate the filters prior to removal.

Carbon breakthrough calculations on the MMD-1 carbon filters is provided in **Appendix 11D**.

11.6.7 Relief System

The relief system stores vapors that may have been vented from the liquid processing system's reagent charge tank and the MTV as a result of abnormal operations. The relief vent tank is a 24-inch OD vessel that is 5 feet long, capped with dished heads, and constructed of 316L stainless steel rated at 70 psig at 330°F. Vapor is released when pressure buildup in the MTV or the reagent charge tank exceeds 165 psig and is discharged through a pressure relief device to the relief vent tank. The relief system will actuate automatically under contingency situations. A schematic of the relief system is presented on **Figure 11-23**. The released vapors flow into the relief vent tank and are later returned to the LRV by the agent injection pump for further processing. If the total relief valve flow exceeds the capacity of the relief vent tank, a relief device on the relief vent tank will discharge vapor to the process trailer ventilation system exhaust duct. If pressure in the relief vent tank reaches 70 psi, vapors will be discharged into the process trailer's carbon filtration system (Ionex) which discharges into the Building 3445, East Chamber carbon filtration system. The vapor is monitored using the MINICAMS[7] monitor of the carbon filtration system. To prevent a fire hazard from potentially flammable vapor contents, a nitrogen environment will be maintained in the tank.

The relief vent tank will be vented to the LRV. This action will be monitored by observing the pressures in the relief vent tank and LRV and from the collection and analysis of a vapor sample from the relief vent tank. The relief vent tank would not be vented unless the problems in the reagent charge tank and MTV that caused the relief vent tank venting are corrected. Prior to venting the relief vent tank to the LRV, a lower pressure than the relief vent tank must be established in the LRV.

The relief vent tank will vent to the process trailer ventilation system exhaust if pressure in the relief vent tank reaches 70 psi. The vapor is monitored using the MINICAMS[7] monitors of the carbon filtration system.

If other MMD-1 tanks and vessels exceed their relief pressures, relief valves will discharge vapor directly to the process trailer ventilation system exhaust duct, which vents to the process trailer's carbon filtration system (Ionex), and then exhausts into the Building 3445, East Chamber carbon filtration system.

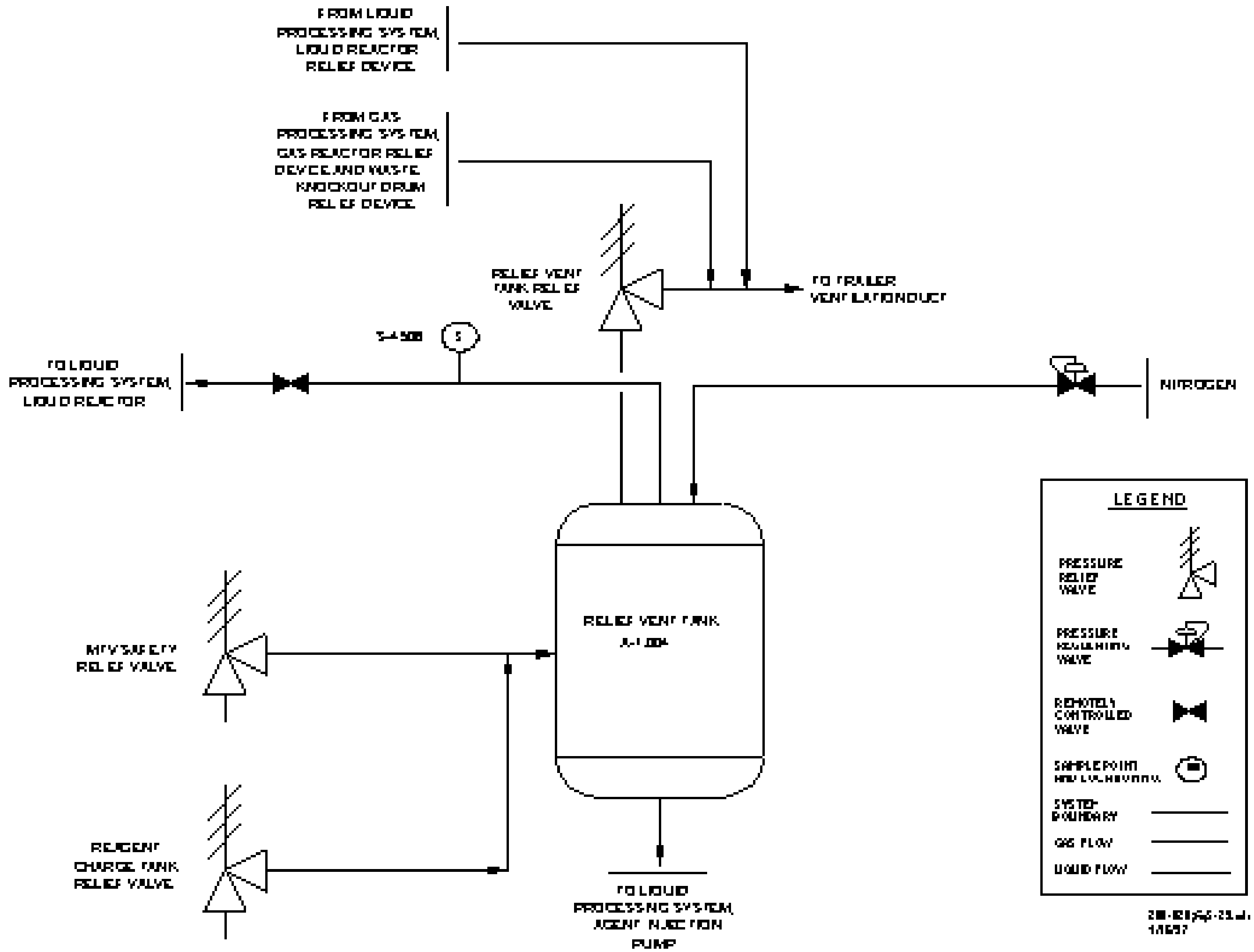

Figure 11-23. Relief System

11.6.8 Piping

Two categories of piping are used in the MMD-1: Category M systems and conventional systems. The process piping systems within the process trailer are designed and constructed in accordance with ASME Category M classification, which allows personnel in the process trailer workspace during treatment. Piping systems outside the process trailer are conventional piping systems. Category M piping has been installed where the concentrations of chemical agent or industrial chemicals are expected to be high. Conventional piping systems are used for gas and liquid piping outside the process trailer and are expected to contain moderate (less than 1 ppm) levels of chemical agent or industrial chemicals.

The process trailer has Category M piping even though the process trailer is always operated as an unmanned space and all operations will be conducted remotely from the control trailer. Category M piping is an ASME service definition for systems that contain materiel that is immediately hazardous even when corrective actions are taken. The ASME code for chemical plant piping requires greater care in designing these systems, restricts the allowable pipe stresses (only allows certain types of piping connections), and requires more testing of the construction. All process piping entering/leaving the process trailer there is an isolation valve that is controlled by interlocks to prevent chemical agent-contaminated fluids from leaving the trailer.

All Category M piping and all liquid waste piping (all piping that can come in contact with chemical agents or industrial chemicals or the neutralents) is 316L stainless steel; in general, other piping is carbon steel.

11.6.9 Utility Systems

This section describes the utility systems of the MMD-1 only. Utility systems for Building 3445 are described in Section 5.2.

11.6.9.1 Instrument Air

The instrument air system will supply air to air-operated valves and other pneumatic control devices to support the air sampling and monitoring system and any other air-related needs. The instrument air system is designed to be a skid-mounted, portable unit suitable for truck transportation. The instrument air system can provide 16.5 acfm of air at 125 psig (maximum). The system will be located inside the West Chamber of Building 3445. The system consists of two 5-hp motor-driven compressors operating on the basis of system demand, and they are mounted on a 120-gallon capacity ASME receiver tank. The system includes air intake filters, air-cooled aftercoolers, service valves, compressor discharge check valves, relief valves, a regenerative desiccant air dryer, a 1.0 micron afterfilter with differential pressure gauge and auto drain valve, and self-regulating pressure controls. The electrical enclosures are designed to National Electrical Manufacturers Association (NEMA) 4 explosion-proof standards. Should system demand require it, both compressors can operate simultaneously, providing 33.0 acfm at 125 psig (maximum). The dryer and filter are sized to accommodate this maximum flow rate.

11.6.9.2 Nitrogen

The nitrogen-generating system is designed to supply nitrogen to all liquid processing vessels before the munition or DOT cylinder is drained and treated. The nitrogen supply serves several purposes in the MMD-1:

- Reduces the presence of oxygen and reduces the likelihood of a fire hazard when flammable liquids or vapors are present

- Recirculates vapors through the sample collection panel in the process trailer so that representative vapor samples are collected

- Pressurizes the liquid process vessels to help gaseous chemical agents or industrial chemicals remain in liquid phase during treatment

- Pressurizes vessels to transfer liquids throughout the system

- Pressurizes the MTV and assists in the check of the hatch seals.

The nitrogen-generating system supplies 722 standard cubic feet per hour (scfh) of 98-percent pure nitrogen at 190 psig at an ambient temperature of 70°F. The balance of purity includes primarily oxygen. The system is designed to be transportable by truck for outdoor operation. The nitrogen system consists of a skid-mounted membrane separation unit, including a motor-driven compressor, nitrogen generator (membrane separator), pressure and purity instrumentation, an 80-gallon capacity air receiver tank with automatic drain, a 120-gallon-capacity nitrogen storage tank, 1- and 0.01 micron dual coalescing filters, and self-regulating controls. The nitrogen-generating system will be located in the West Chamber of Building 3445.

5.6.9.3 Hydraulics

A hydraulic system will actuate the MMD-1 saw motor and tool cylinder hydraulic systems. Part of the hydraulic system is located on a skid outside the process trailer in Building 3445, East Chamber. The remaining system equipment is located in the process trailer. The hydraulic system will deliver 6 gpm of hydraulic fluid to the saw motor with a variable displacement pump of 10-gpm capacity. It has an accumulator tank to provide pressure capacity to the system, and is instrumented with a pressure control valve. The system has valved interlocks to prevent liquids contaminated with chemical agents or industrial chemicals from entering the hydraulic fluids. The tool cylinder hydraulics, located in the process trailer, use low flow demand systems that are controlled by a small displacement pump (0.75-gpm capacity) and feedback controls for modulating the amount of travel.

11.6.9.4 Heating, Ventilation, and Air Conditioning

The MMD-1 process trailer HVAC system is designed to heat, cool, and condition the ventilation air to the process trailer and to maintain a negative pressure. The HVAC system consists of three ceiling-mounted air handling units, two control dampers, a carbon filter with exhaust fan, and a skid-mounted chiller unit. This equipment is designed to heat, cool, and provide air circulation to maintain the inside temperature of the trailer at or about 70°F and a relative humidity of 80 percent or less, with ambient outside temperatures ranging from -10° to 110°F and outside relative humidity ranging from 5 to 95 percent.

The chiller is skid mounted and contains a condenser and pump. The chiller can be remotely operated through the DCIS and is instrumented to provide indications of operation and water temperatures to the control room operator. The system operates with a 50/50 water/glycol mixture. The chiller provides process treatment cooling through the various heat exchangers in the process trailer and provides chilled water to the air handlers for trailer environmental cooling. The HVAC chiller is located outside the process trailer and adjacent to Building 3445, East Chamber.

The air handlers are coil heat exchangers and blowers, equipped with electric heaters for cold weather operation. The fresh air intake damper is provided with a pressure gauge to monitor the negative pressure within the process trailer. The exhaust louver is a fire damper and is controlled by the fire suppression system for shutdown. Condensate lines from the air handlers are drained into the process trailer sump, which discharges to the liquid waste system.

The trailer exhaust air passes through the process trailer carbon filter by means of an exhaust fan remotely operated by the DCIS. The carbon filtration system (Ionex) is instrumented with pressure indicators with remote actuation to the filter damper. The treatment aspects of the process trailer carbon filter are discussed in Section 11.6.6.5. The exhaust fan is capable of operating at 500 cfm and, through dampening the intake, can maintain 0.25-inch negative pressure within the process trailer.

11.6.9.5 Fire Protection System

The process trailer is provided with a 1-hour rated fire barrier that includes walls, floor, ceiling, and all penetrations including access doors. The process trailer is also provided with an automatic fire suppression system using a fire-suppressant gas, FM200, a Halon alternative [National Fire Protection Association (NFPA) 2001 or equivalent]. Both process and control trailers are provided with automatic fire detection systems that alarm locally. A fire detector panel is located inside the control trailer and is equipped with 72-hour emergency battery power supplies. The process trailer is equipped with an ultraviolet/infrared detector to detect fire. Type ABC portable fire extinguishers (two) will also be provided.

11.6.9.6 Steam

The steam-generating system will supply the MMD-1 with a supply of steam for rinsing process vessels (MTV, LRV, liquid waste surge tanks) and for decontaminating CWM munitions or DOT containers that are being processed in the MTV. The steam-generating system is a self-contained electric heater designed to produce 40 gph of water at 100 psig and 325°F or 120 gph of water at 100 psig and 140°F. The system is self-regulating, is intended for intermittent use, and will be located adjacent to the process trailer.

The steam-generating system comprises:

$ Twin ceramic plunger
$ Oil-bath lubricated, positive displacement pumps
$ A safety valve
$ Temperature, pressure, and flow instrumentation
$ A pulsation damper
$ A high-temperature limit switch
$ A low-flow cut-off switch
$ Surge capacity and regulation capability
$ A supply surge tank.

11.6.9.7 Electrical System

The MMD-1 electrical system will provide primary and back up power for MMD-1 operations and will draw power from Building 3445. The electrical distribution system will consist of a 480-V distribution system, a 120-V distribution system, and a 120-V uninterruptible power supply (UPS) system. All system loads will be supplied from the utility grid supply via Building 3445 during normal MMD-1 operations. The main electrical supply cabinet will be located in the electrical equipment room of the control trailer. From this cabinet, all electrical power will be distributed to the MMD-1 systems in the process trailer and the skid-mounted utility equipment.

The main source of power for the MMD-1 treatment operations will be the 480V supply. The 120V system will provide power for loads such as lighting, receptacles, fire-protection panels, diesel generator, and battery charger. The 120V UPS system will provide power for MMD-1 electrical equipment and instrumentation sensitive to power fluctuations and will provide power for MMD-1 critical electrical needs to ensure safe suspended operations until the SDG becomes operational.

An SDG will be provided with the MMD-1 to provide power if the main source of 480V power is unavailable. The SDG, rated at 125 kW, is self-contained and skid-mounted with a weather-protective enclosure. In the event of a loss of normal power from the utility grid supply, a standby diesel generator (SDG) will automatically start and supply critical MMD-1 loads (for example, monitoring systems, DCIS, HVAC, lighting, fire protection/detection, 120-V distribution). A 130-gallon, double-walled fuel tank will be provided with the diesel generator. The generator will be located adjacent to the control trailer. An automatic transfer switch will automatically start the generator when there is a loss of power.

During the time required for the SDG to start, UPS power will be supplied by dedicated batteries/invertors. The UPS is rated for 20 kVA. The batteries will provide 15 minutes of service to critical loads (for example, monitoring systems, DCIS, HVAC).

Building 3445 electrical service will be routed to the MMD-1 control trailer to provide the main power supply for the MMD-1. The MMD-1 SDG will be used as a backup power supply. Building 3445 standby power consists of several portable backup generators capable of supplying standby power to Building 3445 and MMD-1 operations.

Should the main power supply to the MMD-1 fail, the MMD-1 SDG will start within 10 seconds and provide a reduced power capability for the MMD-1. During the interval when power is lost and the SDG re-energizes the 480V bus, critical electrical loads will be powered by the UPS system. In the unlikely event that the MMD-1 SDG does not start, the UPS batteries will provide power for critical electrical loads. During this time, MMD-1 operators will secure MMD-1 operations and attempt to start the MMD-1 SDG manually.

The initial response to a power failure or interruption will be to cease all treatment operations or to continue processing until safe shutdown conditions are met and the MMD-1 is secured. During operations using stand-by power, power will be supplied to critical systems that are required to verify safe suspended operations. These systems include, but are not limited to, the monitoring system, the DCIS, and the HVAC system. The monitoring system will provide information about chemical agent concentrations and releases, the DCIS will provide process monitoring information about equipment and treatment status, and the HVAC will ensure that the MMD-1 carbon filtration unit is functioning.

The MMD-1 electrical systems will be grounded to limit voltages due to lightning, line surges, or unintentional contact with higher voltage lines and to stabilize the voltage to ground during normal operations. Buried grounding cable will be installed for the process and control trailers prior to startup.

The control trailer will be provided with a lightning protection system consisting of: 1) air terminals mounted on the trailer roof at each of the four corners and at the midpoints of the long sides and 2) grounding rods at each site.

11.7 MONITORING/CONTROLS

11.7.1 Introduction

This section presents a summary of the monitoring and process control capabilities associated with the MMD-1. A more detailed description is provided in the MMD-1 Site Monitoring Plan.

Air, liquid, and solid samples will be monitored during the MMD-1 test to identify and quantify levels of chemical agents or phosgene for worker safety and exposure, and for process safety management.

The four monitoring techniques to be used are:

- NRT air monitoring
- Confirmation air monitoring
- Historical air monitoring
- Process monitoring, including liquid waste monitoring.

11.7.1.1 Near Real-Time Air Monitoring

NRT monitors will automatically collect air samples, analyze the samples, and indicate whether an airborne contaminant is present at or above a hazard level. The NRT GC monitoring system (MINICAMS[7]) can detect chemical agent or industrial chemical vapors below, at, or above 1.0 TWA concentrations. **Table 11-10** lists the TWA concentrations for chemical agents and industrial chemical phosgene that will be processed during the MMD-1 test.

The NRT air-monitoring equipment will continuously sample the following locations:

- Inside the process trailer workspace
- Inside the test chamber and support rooms (Building 3445).
- Between Building 3445, East Chamber carbon filter beds
- Unpack Area

If any target chemical is detected in the process trailer workspace, vapor samples from the gas processing system inside the process trailer will also be collected. Similarly, if any target chemical is detected in Building 3445, East Chamber workspace, vapor samples from potential sources of chemical leaks, such as the UPA and the process trailer workspace and gas processing system will be monitored.

11.7.1.2 Confirmation and Historical Air Monitoring

Confirmation and historical air monitoring systems will document conditions over time or confirm a hazard indicated by the NRT systems. They will not be used for immediate warning of hazardous conditions. The confirmation and historical air monitoring systems used for the MMD-1 will be the DAAMS and colorimetric gas detection tubes. Confirmation systems will confirm the results, positive and negative, of the primary monitoring system.

Table 11-10. Time-Weighted Average Concentrations for Chemical Agents and Industrial Chemicals

Chemical	Limits (mg/m^3)
Mustard (HD)	0.003[a, b]
GB (sarin)	0.0001[a, b]
Phosgene	0.4[c]
VX	0.00001[a]

NOTES:
a Department of the Army, AR 385-61 1992
b Oak Ridge National Laboratory, 1992
c Occupational Safety and Health Administration, 1993

11.7.1.3 Process and Waste Residue Monitoring

Samples will be collected throughout MMD-1 process operations. Samples of vapors, liquids, and solids will be periodically monitored for the presence of chemical agent. Vapors from the CWM items or DOT containers will be collected and analyzed before treatment to identify the chemical agent. Vapors and liquids from the treated chemical agent will be monitored for any remaining chemical agent before release of the liquid wastes to surge tanks. Other process wastes, such as reagent and solid debris, will be sampled and quantitatively analyzed for traces of chemical agent or industrial chemical as described in Section 4. Liquid and solid wastes generated from the processing of CWM munitions or DOT containers will be analyzed for a variety of parameters, including presence of chemical agent or fill. Liquid wastes include waste treatment residues from the MTV and LRV, rinse water, process water, and waste gas processing systems. Solid wastes will include the CWM munition or DOT container, CWM item overpack and packing material, spent carbon, debris generated from cutting the munition, and plastic material from CWM munition overpacking. Based on analyses on generator knowledge, these wastes may be hazardous wastes. Waste samples will be collected and analyzed by the Small Burials Contractor (SBC) in accordance with the Waste Analysis Plan described in Section 4.

11.7.2 Treatment Effectiveness

Successful treatment is defined as meeting the treatment performance level goals in **Tables 11-2 and 11-3**. The effectiveness of the treatment process will be monitored through collecting liquid and vapor samples and analyzing and determining chemical agent concentrations in the process residues. After the CWM munition or DOT container has been breached and fill treated, vapor samples will be collected and analyzed from the MTV using a GC/MSD, MINICAMS[7], DAAMS, or sample bomb. Vapor samples will also be collected manually from the LRV, waste gas knockout drum, and relief vent tank for analysis in a GC/MSD. Liquid samples will be collected manually and analyzed in the SBC laboratory for chemical agent contamination for determining when treatment is complete and for characterizing process waste streams. Liquid samples will be collected from the MTV and LRV before being transferred to the surge tanks and from the surge tank when final confirmational analyses are required before offsite transport and disposal can occur. The liquid waste will not be transported offsite for final disposition until laboratory analysis indicates that it meets the treatment performance level goals in **Table 11-2**. A more detailed discussion of MMD-1 waste characterization, including sampling and analysis, is presented in Section 4.

11.7.3 Detection of Releases

The MMD-1 process trailer carbon filter midbed and the process trailer workspace and other areas as outlined in the environmental monitoring plan will be continuously monitored to detect chemical agent or industrial chemical concentration. The carbon filter samples will be analyzed by DAAMS. If chemical agents or industrial chemicals are present, the DAAMS results can indicate whether breakthrough has occurred in the first filter by chemical agent or industrial chemical. The process equipment is designed for leak-tight service; however, in the event of leaks inside the process trailer of either vapor or liquid, NRT monitors, such as MINICAMS[7], will collect and analyze air samples, and an alarm will sound if chemical agent or industrial chemical concentrations equal or exceed their respective TWA.

11.7.4 Work Area Monitoring

Chemical agent or industrial chemical air monitoring in the Building 3445 workspace, Building 3445 support rooms (including the anteroom), the process trailer workspace, the MSM, mobile laboratory, and UPA will be performed to provide warning to workers of the presence of chemical agents or industrial chemicals. These workspaces will be monitored using NRT monitors and DAAMS, which are sorbent tubes. **Figure 11-24** shows the MMD-1 and Building 3445 NRT and DAAMS monitoring locations. **Table 11-11** lists the monitor and sample locations, sample purpose, MMD-1 monitor instrument, and sampling equipment information.

Before opening the MTV or the MSM, the MTV, process trailer, and MSM airspaces will be sampled using an NRT for chemical agents or industrial chemicals. The results will help determine the risk posed to workers who open the MTV or MSM and perform work in those areas. Results will then be used to select additional corrective action and PPE for workers. Monitors for detecting two chemical materiel levels will be used in the UPA. One MINICAMS[7] is set for gross levels, one is set for low level (TWA). The gross level monitor will be used initially to detect leaking munitions, followed by the use of the low level monitor.

11.7.5 Process Monitoring and Controls

A control approach that is widely used in the chemical industry to monitor and control process operations will be used for the MMD-1. The control strategy relies on monitoring, collecting, and interpreting process information at key points in the process that measure characteristics indicative of process status and equipment function. This process information will be used by the MMD-1 operators to control the MMD-1 system. Warning indicators (alarms) are provided to identify pending or actual process upset conditions. The control system monitors process information, provides the operator with several levels of warning indications, and in some instances also initiates prescribed automatic corrective actions by the control system or equipment. For those actions not initiated automatically, operators will initiate corrective action manually.

11.7.5.1 Process Monitoring

The status of MMD-1 equipment is monitored from process data, including temperature, pressure, flow rate, liquid level, and chemical agent concentrations, and detecting chemical agents or phosgene in the workspace of the process trailer. **Table 11-2** presents information on process monitoring. The MMD-1 operators will observe process data from the DCIS computer monitors in the control trailer and at the equipment location. The data will be provided to the operator for informational purposes and normally do not require that corrective action be taken.

a. *Liquid Level.* Liquid levels in tanks will be measured and displayed for all MMD-1 process tanks, including the reagent storage tanks, reagent charge tank, MTV, LRV, gas reactor knockout drum, waste gas knockout drum, vent knockout drum, and surge tanks. Liquid level indicators will provide the status of liquid storage in the tanks to warn operators of operating conditions that may result in damage to the pumps (such as operating the pumps dry) or to warn of a release of liquid if the tanks become overfilled. The MMD-1 operators will be notified via alarms when liquid levels in the tanks are nearing fill limits or when tanks are nearly empty. Liquid levels and alarms are also provided for the trailer sump and reagent storange tank and surge tank skid containments to alert operators to potential leaks from the system.

b. *Humidity.* Humidity will be measured in the vapor stream after it is discharged from the waste gas system's waste gas heater prior to entering the carbon adsorption unit. Operation of the carbon adsorption unit (B-1.101 A and B) is affected by the humidity of the entering vapor stream. The unit works best if the relative humidity is 50 percent or less. The humidity indicator will be used to observe whether the vapor stream humidity has been conditioned by the gas heater to an acceptable level.

c. *Pressure.* Pressures of liquids and vapors will be measured at various points in piping, at the inlets and outlets of pumps and compressors, and in process vessels. Pressure indicators and pressure drops across equipment will provide a status ofthe conditions inside process reactor vessels during reactions and the conditions of pumps, compressors, strainers, and the carbon adsorption unit, and, when used with other process information such as liquid level and temperature, will provide a status of overall operations or of equipment conditions. Equipment and systems are designed, constructed, and selected to operate within certain operating conditions. For example, if the pressure in a vessel meets its relief valve pressure setting, vapor in the vessel is released to relieve the pressure to protect the tank. When pressures are outside normal operating ranges, the MMD-1 operator will be notified through the DCIS via alarms and changes in equipment status as a result of the protective interlocks.

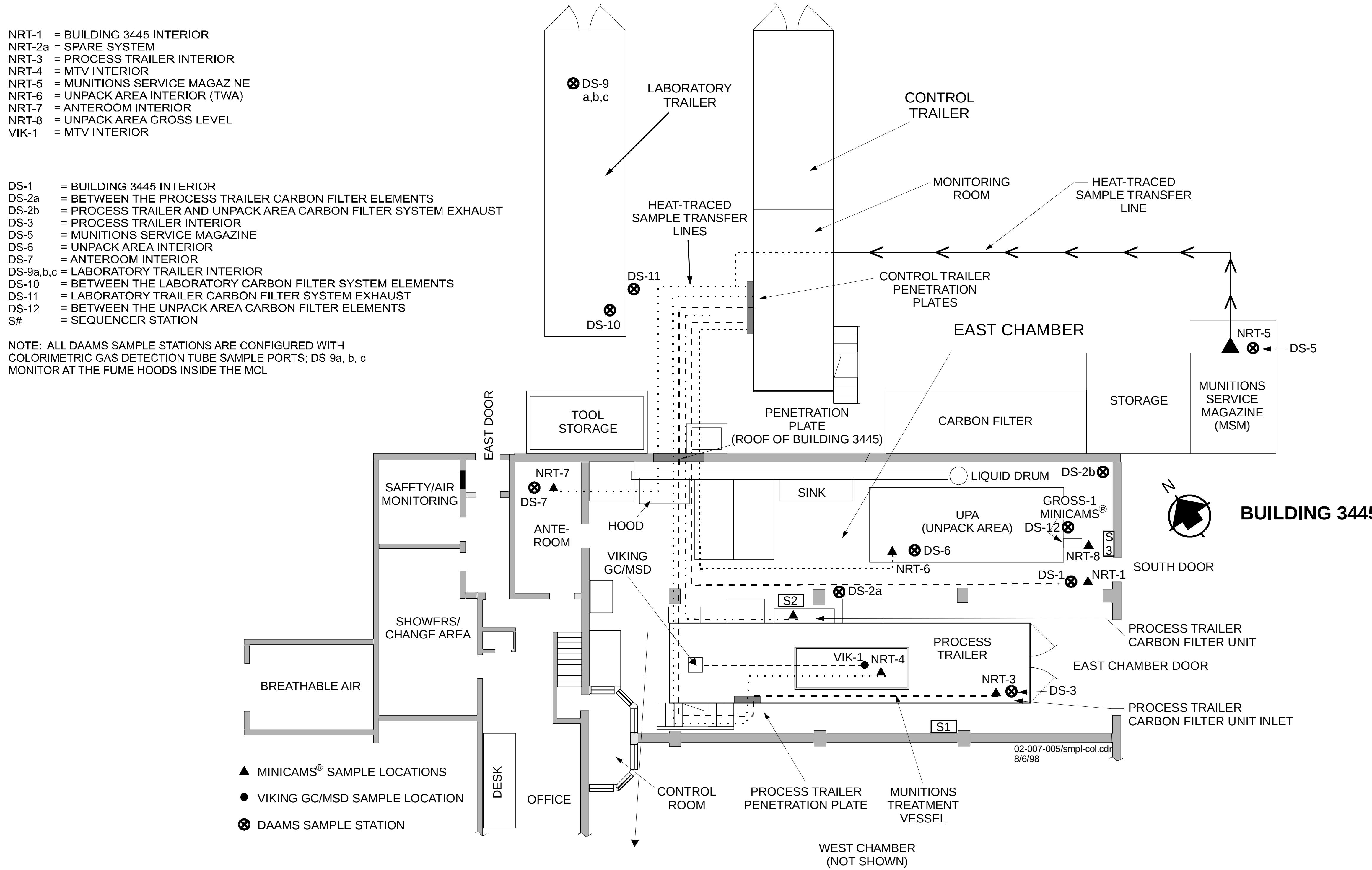

Figure 11-24. MMD-1 and Building 3445 Near Real-Time Monitoring and DAAMS Sample Locations

Table 11-11. Air Monitoring Locations and Monitoring Equipment Type

Monitoring Location	Primary Monitor	Confirmation Monitor	Concentration
Building 3445 Interior (East Chamber only)	MINICAMS[7]	DAAMS	TWA
Between Process Trailer Carbon Filter Elements	DAAMS	DAAMS	TWA
Common Process Trailer and Unpack Area Exhaust	DAAMS	DAAMS	TWA
Process Trailer Interior	MINICAMS[7]	DAAMS	TWA
Munitions Treatment Vessel	MINICAMS[7]	NA	TWA
Munitions Service Magazine	MINICAMS[7]	DAAMS	TWA
Unpack Area Interior	MINICAMS[7]	DAAMS (TWA only)	TWA andAGross Level@
Anteroom Interior	MINICAMS[7]	DAAMS	TWA
Mobile Chemical Laboratory[a]	DAAMS	DAAMS	TWA
Between Unpack Area Carbon Filter Elements	DAAMS	DAAMS	TWA
Between first and second carbon filter elements of the East Test Chamber[b]	MINICAMS[7]	DAAMS	TWA

Notes:
a Only monitored for 1 day prior to 3-day baseline study.
b Performed by DPG personnel

DAAMS = Depot Area Air Monitoring System
DPG = Dugway Proving Ground
MMD-1 = Munitions Monitoring Device, Version 1
TWA = time-weighted average

d. *Temperature.* Temperatures of liquids and vapors will be measured at various points in the piping, and at the inlets and outlets of pumps, compressors, and process tanks. Temperature readings provide a status of the conditions inside process vessels, and the conditions of pumps and compressors during operation, and are used with other process information, such as liquid level and pressure, to provide a status of overall operation. Equipment and systems are designed, constructed, and selected to work within certain operating conditions. For example, if the temperature in the gas reactor exceeds its high temperature setting, the gas reactor is bypassed and the vapor is directed into the waste gas knockout drum. Elevated temperatures in the gas reactor will indicate that the NaOH-impregnated carbon may be spent and requires replacement. When temperatures are outside normal operations ranges, the MMD-1 operator will be notified through the DCIS via alarms and changes in equipment status as a result of the protective interlocks.

e. *Flow.* Flow rates of liquids and vapors will be measured to indicate the status of pumping operations. Flow rate measurements will be used with other process information (such as liquid level and pressure) to provide a status of the overall pumping operations. Areas monitored for flow are: reagent/process water supply to the reagent storage tanks, cooling water to the various heat exchangers, reagent fill/recirculation/waste transfer pump, and steam flow to the pressure wand.

f. *Chemical Agent.* Chemical agent concentrations will be measured in liquids and vapor process streams. Concentration values will be evaluated along with other process information to determine treatment progress.

11.7.5.2 Process Controls

MMD-1 process controls consist of the use of alarms and trips/interlocks.

. a. *Process Alarms.* An audible and visual process alarm will signify that the process is operating above or below an established setpoint (for example, temperatures above the normal operating range or a liquid in a tank above a pre-set level). No corrective action is initiated by the control system, but the operator may be required to take corrective action. The MMD-1 design has identified process operating ranges for treatment process equipment. When process monitoring data indicate measurements outside these ranges (that is, less than or greater than the values within the range), then an audible and/or visual alarm will be displayed on the DCIS monitor to notify the operator of a potential problem. An example of a process alarm for a liquid storage vessel is the high-level alarm that indicates when the liquid level in a vessel is greater than the level set for its normal operation. Corrective actions are displayed on the DCIS monitor and are detailed in the MMD-1 Standing Operating Procedures (SOPs). Corrective action for a high liquid level alarm would be to close selected valves to the tank being filled and/or shut off the pump that is filling the tank.

b. *Trips/Interlocks.* Trips/interlocks are automatic controls that will be directed by the DCIS through its predetermined programming or by mechanical field devices that halt the operation that is causing the process parameter to be out of its normal operating range. Appendix 11E lists some of the critical trips and interlocks. A trip is normally initiated only after an alarm condition has been indicated and the process parameter value continues to exceed its operating range. An example of a trip for a tank is the indication of a rising liquid level in the tank above the high alarm level to the high-high alarm level. The control system will automatically close valves on the lines that supply liquid to the vessel and/or shut off the pump that is filling the tank.

Certain trips/interlocks can be overridden to allow operators to take manual control of the operation. An example is the low-low level trip for the reagent fill pumps. Normally, these pumps are automatically stopped on low levels in the suction tank to prevent potential pump damage caused by cavitation. However, the low-low level trip can be overridden during tank clean-out to allow the tank to be emptied by the operators while they closely monitor the pumps for cavitation.

Trips/interlocks are also provided to prevent fluids or vapors in the systems containing agent from flowing back into systems that do not contain agent

The trip/interlock will be initiated whenever the pressure in the system containing agents is greater than the pressure in the system that does not contain agent (for example, process water, instrument air). The control system automatically closes an air operated valve to prevent the flow between the piping systems.

Table 11-12 presents a summary of process monitoring controls for key MMD-1 equipment. Additional information about process controls and operating parameters is presented in Appendix 11E.

11.7.6 Closed-Circuit Television System (CCTV)

A total of eight CCTVs will be present in the MMD-1 to allow the MMD-1 control room operators to monitor operations. Four CCTV process cameras will be located in the MTV vessel to enable the operators to closely monitor the CWM munition or DOT container breaching and cutting operations. Two cameras will be located in the process trailer to monitor the spaces and equipment. Two CCTV surveillance cameras will be located in the UPA to monitor workspace activities. Two CCTV monitors will be used for viewing: one in the MMD-1 control room and one in the control trailer. Each will have split-screen capability to enable simultaneous viewing of all four MTV camera views or both trailer camera views. A VCR recording capability will also be added to record operations, as required.

11.8 OPERATION AND MAINTENANCE

11.8.1 Startup

Prior to accepting any CWM munition or DOT container, the operator will verify the operation of the utility systems, the presence of an adequate supply of process water and of reagents in the reagent storage area, and that no tagout conditions for maintenance or alarm conditions exist.

11.8.2 Normal Operation

The MMD-1 will process from one to four CWM munitions or DOT cylinders per day. All munitions or DOT containers with the same chemical agent or industrial chemical will be treated in a campaign to allow the maximum reuse of reagent until it is determined to be spent. The status of the reagent will be verified through periodic sampling. Between unloading and loading operations at the MTV, the reagent intended for reuse will be temporarily stored in the LRV. When there is a change of chemical agent or industrial chemical, or when the reagent has been determined to be spent, the LRV will be drained to the liquid waste system and the LRV will be rinsed as needed. The MTV is normally rinsed after treatment has been completed to facilitate entry for unloading the CWM munition or DOT container and fixture and reloading with a fresh CWM munition or DOT container.

11.8.3 Shutdowns

Normal shutdown of the MMD-1 involves returning equipment to the standby operating status associated with the equipment prior to treatment operations. A normal shutdown condition is reached when CWM munitions or DOT containers are no longer being processed. The reagent tank contents, valve positions, vessel liquid levels and contents, pump operability, and safety system readiness are verified. Normal shutdown procedures will also include clearing the equipment for maintenance in the event of an equipment degradation or nonemergency failure. The normal shutdown can be performed after the treatment of a CWM munition or DOT container is complete. Normal shutdown procedures will not be affected by the amount of down time experienced from equipment failures.

Table 11-12. MMD-1 Process Monitoring Controls

	Process Vessels[a]	Pumps/Vacuum Pump	Process TrailerGas Exhaust	Process Trailer Liquid Waste Stream Discharge	Category M[b] Boundary
Process Monitoring	$ Liquid level $ Pressure $ Temperature $ Agent and reagent concentration level $ pH	$ Run status $ Suction and discharge pressure $ Differential pressure $ Discharge flow rate $ Temperatures for compressor	$ Pressure $ Temperature $ Humidity	$ Temperature $ Flow rate	$ Isolation valve position status
Alarms	$ High limits: Pressure Temperature Liquid level $ Dike liquid level Reagent and surge tanks $ Low limits Liquid level pH	$ High and low differential pressure $ High temperature in compressor	$ Humidity	None	$ High Pressure valve stem leak off
Trips[c]	$ High-high and low-low limits: Liquid level $ High-high Temperature in LRV and RST (heater) and GR	None	$ High temperature trips closed key locked isolation valves	$ Low Flow trips closed key locked isolation valves	$ Low Differential Pressure $ Low Flow
Manual Interlocks	None	None	$ Key switch supervisor initiation required to transfer gas exhaust across Category M boundary from WG K/O	$ Key switch supervisor initiation required to transfer liquid wastes across Category M boundary	None

NOTES:

a Process vessels include: MTV, LRV, Reagent Storage Tanks, Reagent Charge Tank, Liquid Waste Surge Tanks, Relief Vent Tank, Gas Reactor Knockout Drum, Gas Reactor, Waste Gas Knockout Drum, Vent Knockout Drum.
b Category M Boundary is ASME Category M piping system connection points (boundary) with conventional piping systems.
c Trip conditions initiate valve operation or stoppage of running equipment in order to prevent equipment damage or fluid or gas releases.

GR = gas reactor
LRV = liquid reactor vessel
MTV = munitions treatment vessel
WG K/O = waste gas knockout drum

Design margins, controls, and administrative measures are adequate to prevent a catastrophic event. Some combination of failures and events might result in a nonroutine situation; for example, a nonroutine situation would occur when the ability of the operator to prevent a release or to contain an event (such as a fire) with existing controls or equipment is temporarily lost or severely compromised. This situation will warrant emergency measures, such as an accelerated (emergency) shutdown of equipment. Emergency shutdown of the MMD-1 will involve returning equipment to a stable and controlled status (within engineering control) after operations have been either quickly stopped or after operations and treatment processing have been allowed to continue briefly in order to reach an equipment and system status that is comparable to that of a normal shutdown. In this situation, equipment may be in need of repair. Emergency shutdown procedures will allow for quick stabilization of process temperatures, pressures, flows, and chemical concentrations so that personnel safety can be ensured and the potential for releases can be minimized or prevented. Emergency shutdown procedures will be performed in the same manner and will not be affected by the amount of down time experienced from equipment failures.

11.8.4 Other Than Normal Processing Operations

Operational procedures have been developed to respond to other-than-normal operations, such as the failure of the MMD-1 system during various scenarios. Engineering controls will be maintained to prevent the release of liquid or vapor chemical agent or industrial chemical in the event that problems arise during the cutting of the munition body or DOT cylinders, and a munition is only partially cut. Then every effort will be made to return the equipment to a stable and controlled status. When problems are encountered, the goal will be to continue the operation in a safe manner and contain the chemical agent or industrial chemical. The Hazard Assessment Working Group will be called upon to evaluate each situation and identify remedies, maintenance, or repairs needed to continue normal operations. Several situations and corresponding operational responses are described below.

Situation 1: Pressure buildup in MMD-1 equipment.

Response 1: In general, pressure buildup in the reactor vessels results from several activities. One is from the generation of heat from the exothermic treatment reactions. Another is from the introduction of gases from the CWM items or DOT cylinders at the time they are initially cut. Pressure in vessels also varies as nitrogen gas is introduced into the vessels during purging of air and testing of the MTV seals. Also, the vessels are pressurized with nitrogen gas to transfer liquid within the system. The relief system will operate on a contingency basis, like an incinerator emergency bypass vent.

Buildup of extra pressure in the MMD-1 reactor vessels would primarily occur during exothermic treatment reactions. Consequently, controlling the rate of combining reagent with chemical agent/industrial chemical will reduce the rapid buildup of temperatures and pressure. In addition, temperatures and pressure can be reduced through the use of the liquid reactor cooler and cooling effect resulting from the heat dissipated from the MMD-1 vessels and piping.

Situation 2: A failure in the MMD-1 system occurs after a CWM item has been transported from the MSM and is now in the UPA and awaiting processing.

Response 2: If an MMD-1 equipment failure occurs after the CWM has been moved to the UPA but has not been unpacked, the CWM will remain in the UPA and then processed after the equipment is repaired.

Situation 3: A failure in the MMD-1 system occurs after a CWM item is in the UPA and has been unpacked from the overpack container.

Response 3: In general, the MMD-1 is in a standby state before a munition or DOT cylinder is removed from the MSM for processing in the MMD-1. If problems with equipment are encountered after the CWM item has been moved to the UPA and/or has been unpacked, the munition will remain in the UPA and the processing of the CWM will be delayed until the problems are resolved.

Situation 4: A failure in the MMD-1 system occurs after a CWM item has been processed in the UPA, transported to the MTV, and its body cut by the MTV cutting tools.

Response 4: If an equipment failure occurs after the CWM is breached, whenever possible the liquid and vapor in the MTV will be isolated by closing appropriate valves and sealed from the process trailer workspace, and processed after the equipment is repaired.

Situation 5: Liquid waste in the surge tanks does not meet performance treatment level goals.

Response 5a: This is one of three operational procedures that could be performed to treat contaminated liquid waste in the surge tanks. Reagent would be added to the surge tanks, recirculated, and waste samples collected and analyzed. If additional treatment was needed, additional reagent would be added, and the mixture recirculated. These steps are repeated until the performance treatment level goal is met.

Response 5b: The second possible operational procedure is as follows: transfer the waste from the surge tank via flexible hose to the MTV. Add reagent to the MTV, recirculate, sample, and transfer that liquid to the surge tank when performance treatment level goal is met.

Response 5c: The third alternative procedure would be to transfer waste from the surge tanks to the Reagent Storage Tank, then to the MTV. Add reagent to the MTV, recirculate, sample, and transfer the liquid to the surge tank when the treatment performance level goal is met. The reagent storage tanks will then be rinsed with clean process water. The rinsate would then be collected in the surge tanks and managed appropriately based on sampling and analytical results.

11.8.5 Maintenance

Planned maintenance of the MMD-1 process equipment and supporting systems will help ensure that the equipment remains capable of performing to design functions. During the MMD-1 test, preventive maintenance will be identified for all major equipment systems and will specify replacing equipment components that are limited by material life or heavy use, including filter media, lubricants, critical bolting on pressure vessels, seals, batteries in emergency lighting and fire protection systems, transport containers, munitions fixtures, and templates.

Based on the development of the MMD-1 test and information gained as a result of testing operations, a maintenance program will be developed that reflects lessons learned as well as good industry practice.

11.9 WASTE MANAGEMENT

11.9.1 Introduction

Both solid and liquid hazardous wastes will be generated from MMD-1 test activities. Liquid hazardous waste generated will consist of rinse waters and decontamination solutions and neutralent, which is the waste stream generated from the reaction of the treatment reagent and the chemical agent or industrial chemical treated. Solid hazardous wastes will include the empty munition body or DOT cylinder and any soil, debris, or particles dislodged and collected in strainers during the treatment process. **Table 11-13** summarizes the type of wastes generated by each MMD-1 process activity or location.

All MMD-1 process wastes will be properly containerized, characterized, (F999 and other waste codes assigned as applicable), and labeled to ensure proper management. Characterization will be conducted according to the Waste Analysis Plan detailed in Section 4 of this permit application. This section presents a general overview of MMD-1 waste management activities, including the types of wastes that will be routinely generated from the MMD-1 test activities and processes, and a description on handling and disposition. Also described is the waste tracking system that will be used to track the munitions processed in the MMD-1 test and the other waste streams as they are generated, stored, and shipped offsite to a permitted TSDF for further treatment and/or ultimate disposal.

11.9.2 Unpack Area - Pre-Treatment

In the UPA, overpacked munitions or DOT cylinders will be prepared for processing. The UPA activities performed prior to treatment involve unpacking munitions from overpacks, checking for leakage, and attaching the munition or DOT cylinder to the MTV fixture for treatment in the MTV.

Pre-Treatment Operations. Unpacking the munition will be performed over the UPA work bench. The work bench is made of stainless steel and is designed with an opening in the bottom to funnel any waste into a 30 gallon DOT-approved container, which is equipped with a secondary containment pallet pan. All waste liquids and solids will be placed into the container.

Pre-Treatment Wastes. Solid wastes such as overpack material from CWM items to be treated, including the overpack container, packing material such as rags, and wood, will be routinely generated when the CWM is unpacked. If these wastes are contaminated with chemical agent, they will be decontaminated and decontamination residue will be managed as hazardous waste. If the overpack material is not contaminated with chemical agent, it will still be managed as hazardous waste in order to simplify waste management.

Table 11-13. Summary of MMD-1 Wastes by Activity/Location

Activity/Location	Wastes Generated
Unpack Area - Prior to treatment	$ Overpack material from CWM items $ Soils/debris from CWM items $ Used personal protective equipment $ Decontamination wastes
MMD-1 Treatment	$ Detoxified chemical agent liquids (neutralent) $ Detoxified industrial chemical liquids (neutralent) $ Used activated carbon $ Rinse waters $ Used personal protective equipment $ Soils/debris from CWM items $ Reagent solids
Unpack Area - Post-Treatment	$ CWM munition bodies[a] $ DOT cylinders[a] $ Spent abrasive blast material $ Used personal protective equipment $ Decontamination wastes $ Metal Filings
Mobile Laboratory	$ Laboratory wastes $ Used personal protective equipment
Personnel Decontamination Station	$ Liquid decontamination solutions

NOTE:
a. CWM munition bodies will be sent to U.S. Army Rock Island Arsenal for reclamation.

During other than normal operations, such as when leaking CWM is unpacked, both solid and liquid hazardous wastes will be generated. Solid hazardous wastes will include the agent-contaminated overpack container and packing materials. If the munition is leaking, the overpack and munition will be decontaminated by wetting the overpack and munition with liquid decontamination solutions followed by a manual wipe down and clean water wetting. Spent decontamination solutions and rinse water wastes will be generated when decontaminating work surfaces, overpack container, and worker PPE.

All solid and liquid wastes will be placed into DOT-approved containers (drums) and sealed. These containers will be stored in a designated area of the UPA, which will be operated as a less than 90 day waste storage area. Prior to transferring these containers from the UPA to an offsite permitted TSDF, headspace sampling will be conducted of the drum contents and of the exterior of the drum.

11.9.3 MMD-1 Treatment Wastes

The treatment of chemical agent or industrial chemical occurs in the MMD-1 liquid processing, gas processing and waste gas processing systems. All of these systems are located in the process trailer. Both liquid and solid wastes that will be routinely generated during processing will require further treatment at an offsite TSDF. However, the gas processing and waste gas processing systems do not generate a gaseous waste stream that requires additional treatment.

11.9.3.1 Liquid Processing System

The CWM item is loaded into the MTV and its contents are mixed with reagent. The treatment can occur in the MTV, in the LRV, or in both treatment vessels. In all cases, the liquid neutralent (product of the reaction) will be generated and will be managed as a hazardous waste. The other liquid waste stream that will be routinely generated is the rinse waters that result from the flushing of the treatment vessels and piping (MTV and LRV) with water to remove neutralent. Rinse waters will not be mixed with the neutralent waste stream and will be managed as a separate liquid hazardous waste stream in order to develop a waste profile.

Solid hazardous wastes will also be routinely generated in the liquid processing system (MTV). These solids are associated with the munition body inside the MTV. Solid materials that will be retrieved manually from the MTV include: the munition body (or DOT cylinder as applicable); metal filings generated during cutting the coupon; plastic wrap; and plaster of paris or other debris that was lodged onto the munition when it was introduced into the MTV and became dislodged during treatment. The munition body or DOT cylinder will be removed still attached to the MTV fixture. The metal filings and other debris will be manually picked up using tongs or other hand-held tools from the bottom of the MTV and carriage assembly and placed into 30 gallon DOT-approved metal drums. Other solids trapped in the MTV basket strainer or in the liquid filters (two) will also be retrieved manually by inverting the strainer over a 30-gallon
DOT-approved container to dislodge the material. Tongs or other hand-held tools may also be used to remove the material. Once containerized, the material will be managed as hazardous waste.

11.9.3.2 Gas and Waste Gas Processing Wastes

The gas processing and waste gas processing systems do not generate a gaseous waste stream that requires additional treatment. All air emissions will be required to be less than 1.0 TWA for chemical agents or industrial chemicals.

Liquids that are removed by knockout drums from the vapor stream in the gas and waste gas processing systems are drained into the MTV and combined with the liquid waste streams there. No other liquid waste streams are routinely generated in the gas and waste gas processing systems.

Solid wastes routinely generated consist of spent NaOH-impregnated carbon from the gas reactor; spent activated carbon from the carbon adsorption units (carbon canisters); and spent activated carbon from the carbon filtration system (Ionex). In each of these cases, the spent carbon will be replaced when operational alarms indicate that breakthrough of chemical agent or industrial chemical is detected. The spent carbon for each of these subsystems will be manually removed and replaced. The gas reactor spent carbon will be vacuumed out of the reactor vessel and fresh carbon poured into the vessel. The spent carbon in the carbon adsorption units will be replaced when new carbon containers and carbon are installed. The spent carbon and their containers will be managed separately from other carbon wastes. The spent carbon from the carbon filtration system will be replaced using its bag-in/bag-out procedure. All spent carbon wastes will be containerized, air vapor monitored, and stored in a less than 90-day waste storagearea pending shipment offsite to a permitted TSDF for further treatment and/or ultimate disposal.

11.9.4 Unpack Area - Post-Treatment Wastes

Several operations will be performed in the UPA on the munition body following treatment in the MMD-1 process trailer. These operations include size reducing the munition bodies and bead blasting the munition body parts. Size reduction and bead blasting are required to prepare the munition bodies for acceptance as recyclable material at the U.S. Army Rock Island Arsenal, IL, for smelting.

The types of waste routinely generated during cutting and abrasive blasting operations are: metal cuttings from the saw, abrasive media, paint residue, and munition body parts (two halves, rotating band, and burster tube pieces).

The munition body will be cut in half with a guillotine saw and then bead-blasted inside a glovebox located in the UPA. Both inside and outside portions of a munitions body will be bead-blasted. After clean out of the saw and abrasive blaster, the cuttings and abrasive media and other solid residue will be placed in a DOT-approved container and managed appropriately as hazardous waste.

The blasting activity will be conducted within a glovebox attached to a ventilation system containing a particulate prefilter to remove particles and a carbon filter to minimize particulate emissions. Because of the particulate prefilter, no adverse impact to the charcoal filters is anticipated. DOT cylinders will not be size reduced or bead blasted. They will be containerized in the UPA and managed as recyclable material.

11.9.5 Managing Accumulated Liquids

Secondary containment pans and secondary containment systems will be used to contain any spills, leaks, or other liquids, such as condensate, that might accumulate as a result of MMD-1 test operations. With the exception of any liquids observed in the process trailer sump, liquids will be removed from secondary containment pans and systems by either pumping the liquids out using a portable centrifugal pump, vacuuming by use of a wet vacuum, or absorbing the liquids using compatible absorbent material such as pillows, granules, sheets, or socks. These absorbed, pumped, or vacuumed waste materials will be placed in DOT-approved containers and managed as hazardous wastes.

In most instances, liquid material in a secondary containment pan or containment system will be known (for example, liquids in the reagent storage tank secondary pan). If, however, a material is unknown or its origin questionable, the material will be sampled and analyzed.

For liquids found or observed in the process trailer sump, the liquids will be transferred to either the MTV, LRV, or surge tanks for processing. For safety reasons, the material will be assumed to contain chemical agent.

11.9.6 Type of Waste Containers

The type of waste containers to be used during the MMD-1 test will be DOT-approved. The list of container types, UN code, and waste material to be contained is presented in **Table 11-14.**

11.9.7 Marking and Labeling Waste Drums/Containers

Each hazardous waste container generated during MMD-1 test activities will be appropriately labeled in accordance with 40 Code of Federal Regulations (CFR) 262.31, 262.36 [R315-5-8(b),(c), and (d)] and DOT (49 CFR Part 172) regulations. Hazardous waste containers will be affixed with a Ahazardous waste@ label that will contain, at a minimum, the date of accumulation, associated waste codes, and generator name and address.

Before transportation offsite, containers will be marked according to the requirements in 49 CFR Part 172 and will include the DOT shipping name, waste codes, hazard class, manifest document number, and an indication if the material is a reportable quantity (RQ).

Table 11-14. Types of Waste Containers

Container Type	Manufacturer	UN Code	Waste Material
350 gal stainless steel bulk container	Crawson Container Co.	UN31A/Y	Liquid Neutralent; Liquid Process Wastes; Rinse waters; System cooling water
30 gal O/H phenolic lined drum	Inmark	UN 1A1/Y1.2/100	Solids from MTV strainers; Munition and DOT cylinder parts; Spent Activated Carbon; Plastic, soil, debris; Overpack material; Used personal protective equipment; Contaminated MMD-1 equipment parts
55 gal O/H phenolic lined drum	Inmark	UN 1A2/Y1.5/150	Solids from MTV strainers; Munition and DOT cylinder parts; Spent Activated Carbon; Plastic, soil, debris; Decontaminating overpack material; Decontamination wastes; Used personal protective equipment; Contaminated MMD-1 equipment parts
55 gal T/H phenolic lined drum	Inmark	UN 1A1/Y1.8/300	Lab wastes; Hydraulic fluids

11.9.8 Disposition of Waste Streams

With the exception of munition body parts and other recyclable material, the MMD-1 process wastes will be temporarily stored (less than 90 days) onsite in one of three waste storage areas pending shipment offsite to a permitted TSDF for treatment and/or ultimate disposal. Less than 90 day waste storage areas will be located in the UPA, the West Chamber of Building 3445, and southeast of Building 3445 on AA@ street.

11.9.9 Waste Tracking

Hard copy Department of the Army (DA) forms and a SBC computerized waste management information system will be used to track a CWM item and its associated generated waste streams, to meet the requirements of R315-8-5.3 (40 CFR 264.73 Operating Record). The following text describes how tracking will be conducted.

Each munition and DOT cylinder will have been characterized prior to arrival at Building 3445. Information compiled about a munition or DOT cylinder will be associated with a unique identification number assigned to a munition or DOT cylinder and this information will be entered into the SBC data base. The U.S. Army identification numbers will be used for munitions and the SBC will assign identification numbers to the DOT cylinders. These individual identification numbers will become the common field used as a cross-reference in documenting the location and disposition of a munition or DOT cylinder, process and waste characterization samples collected, wastes generated as a result of processing a particular munition or DOT cylinder, and wastes shipped offsite to a permitted TSDF or to the U.S. Army Rock Island Arsenal for reclamation.

The DA Form 4508 will be used to document the transfer of CWM from Igloo G to the MSM at Building 3445. Information fields on DA Form 4508 meet the minimum requirements of R315-8-5.3 and include the date the materiel is transferred, a description and quantity of the materiel transferred, and the location to which it is transferred. One DA Form 4508 is used per transfer. Several CWM items can be transferred at a time and noted on one form. Before actual transfer, the Chemical Surety Materiel (CSM) Accountable Property Officer will fill out the form and complete the information fields. A document control number is assigned to the DA Form 4508, recorded on the form, and registered in the DPG document number control register. Upon transfer of the materiel to the MSM at Building 3445, an escort officer will verify that the CWM to be delivered is the one(s) identified on the DA Form 4508. Once the CWM arrives, the DPG Test Director will inspect the CWM item(s), verify that it is the one(s) noted on the DA Form 4508, and sign the form thus accepting the materiel for use in the test and storage at the MSM.

A copy of the DA Form 4508 is then returned to the CSM Accountable Property Officer to annotate the control number register, post changes to the manual custodial record, and update the Igloo G storage planograph.

Once the CWM item has been accepted by the DPG Test Director for use in the MMD-1 test, the SBC computerized waste tracking system will be used. After acceptance of the CWM at the MSM, the SBC will enter the pertinent identification numbers into the data base noting date, time, what the items are, and that they are stored in the MSM. On removing a munition or DOT cylinder from the MSM to the UPA, operators will note date, time, identification number, and that the item has been moved to the UPA. At the UPA, wastes generated from the unpacking of a munition will be placed into containers that will be bar coded with unique identification numbers. The bar coded number will then be cross-referenced against the identification number of the munition so that each bar coded container of waste generated from a munition can be traced back to the unique identification number of that munition.

The operators will note date, time, and identification number of CWM items or DOT cylinders each time they are moved during processing, including, when the munition or DOT cylinder is ready for transport to the MTV, when the item has been moved to the MTV, when the item is at the MTV to begin processing, and at the onset of processing.

Throughout the processing, the unique identification number assigned to the munition or DOT cylinder will be used in documenting the progress of the process activities as well as documenting any samples collected. For example, a sample collected from the sample panel will be given a numerical identifier which will be cross-referenced to the munition or DOT cylinder unique identification number. This information will be entered into the SBC data base along with the date and time the sample was collected. Similarly, the sample results will also be entered into the SBC data base and cross-referenced to the munition or DOT cylinder unique identification number.

Liquid neutralent wastes generated will be initially contained in one or both surge tanks. Each surge tank will be bar coded with a unique number. Several munitions or DOT cylinders may be associated with the contents of a surge tank due to batch processing by chemical agent or industrial chemical phosgene campaign. As a neutralent waste is added to a surge tank, the surge tank barcode number will be cross-referenced against the unique munition or DOT cylinder numbers and entered into the data base. When the neutralent is transferred from the surge tanks to the bulk waste storage containers located in the West Chamber of Building 3445, the operators will note date, time, and the barcode number(s) of the surge tank(s) and enter the information. Like the surge tanks, the bulk waste storage containers in the West Chamber will be bar coded and cross-referenced against the surge tank barcode and the unique munition or DOT cylinder identification number.

When a munition or DOT cylinder body has completed processing, the operators will note the date, time, unique identification number and note that the item has been removed from the MTV, transferred to the UPA, and received. Munitions will be stored speculatively until enough material is present to begin size reduction and beadblasting. When a munition body is brought back to the UPA from the MTV it will be placed into a DOT-approved container and the container bar coded. As additional munition bodies are added to the container for storage, the bar coded container will be cross-referenced against the unique identification number of those munitions. Wastes generated from beadblasting and size reduction activities will be placed into barcoded containers, which will be cross-referenced against one or more containers containing munitions and the unique munition or DOT cylinder identification numbers.

Other wastes generated from the test activities (for example, decontamination solutions, residues at closure) will be containerized and given unique barcode numbers. The location and disposition of all waste containers will be documented through the barcode numbers and entered into the SBC database.

When wastes are shipped offsite, the barcode numbers on each container to be shipped will be entered into the SBC data base and cross-referenced against the shipment manifest number.

Following treatment of a CWM item(s) the remarks section of DA Form 4508 will be completed for destruction confirmation and signed by the DPG Test Director. A copy of the form will be provided to the DPG CSM Accountable Officer and a copy will be retained by the DPG Test Director.

11.9.10 Manifesting and Certification/Notification

The manifesting requirements established in 40 CFR 262.20 through 262.23, 264.70, and R315-4-1 and 4-2 will be followed prior to shipment of MMD-1 wastes offsite to the approved hazardous waste TSDF. All MMD-1 hazardous waste shipments from DPG will be accompanied by a completed hazardous waste manifest.

The manifest of the state of import will be used unless that state does not have its own specific manifest, in which case the manifest of the state of export (Utah) will be used. If neither state has a specific manifest, the Uniform Hazardous Waste Manifest will be used. Manifests will be signed by an individual authorized by the DPG Commander and will be completed in accordance with EPA, State, and DOT regulations.

A Land Ban Certification/Notification, which includes applicable universal treatment standards, will accompany each manifest and shipment of MMD-1 hazardous waste to the receiving TSDF. The certification will be in accordance with 40 CFR 268.l7 (R315-13-1). The certification will include, at a minimum, EPA hazardous waste number, corresponding treatment standards, and manifest number of waste shipment. The certification will be signed by an authorized representative of the SBC.

Signed copies of the manifest and certification/notification will be maintained by the SBC for each waste shipment.

11.9.11 Transportation of MMD-1 Wastes Off DPG

Shipments of MMD-1 waste from DPG to an approved hazardous waste TSDF will be performed by approved, licensed, hazardous waste transporters. All shipments will be accompanied by a completed hazardous waste manifest. All transportation will comply with DOT regulations with respect to packaging, labeling, marking, and transportation of waste (49 CFR Parts 171 through 179).